JOYVO A WEIKEM COMPANY | 中福生物 JOYVO WEIKEM BIOLOGY


***JOYVO NEW MATERIAL CO., LTD ( A WEIKEM COMPANY )***
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## Create a Beautiful & Healthy Life

# JOYVO *FIND. ENJOY*

- *Hyaluroinc Acid*
- *Cationic Hyaluronic Acid*
- *Collagen*
- *Pullulan*

# About Us

July, 2006

Joyvo is born. Joyvo started OEM work on Hyaluronic Acid and Collagen.

Feb, 2009

Joyvo started own branding marketing.
Hyaluronic Acid –AquaJuve
Collagen-- IvyLanc
Joined in WeiKem group.

Jun, 2012

We have new facility and headquarter in Yangzhou Food Industrial Zone.

Sep, 2013

PQ-10 & Guar Hydroxypropyltrimonium Chloride NatiFelx Series, PuriCell Series and AquaJuve Plus were officially launched.
We started importing and distributing work on aboard cosmetics, nutraceutical ingredients.

May, 2014

Pullulan DuoLux were officially launched.
Two new facility was established by investment.
A new Coffee Roasting production line settled

Jan, 2016

Joyvo HA expended in personal care area.
Cationic Hyaluronic Acid NatiFlex HA600 and NatiFlex HyaMate were officially launched.
As moisturizing factor, cationic hyaluronic acid canbe used in shampoo, hair conditioners.

# HYALURONIC ACID

**INCI Name**: Sodium Hyaluronate

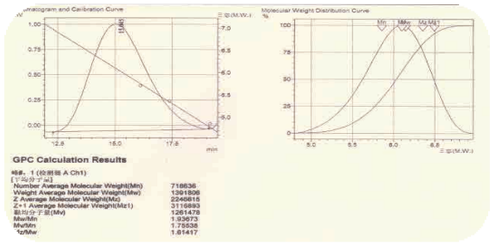
**CAS NO.** : 9067-32-7

**Chemical Name**: Sodium Hyaluronate

Hyaluronic acid is a linear polysaccharide of high molecular weight, naturally occurring in the human body. It is applied here as a connective tissue organizer and hydrating substance on the basis of its status as the most hydrating polymer known. The enormous water-binding capacity of hyaluronic acid is an essential characteristic influencing its biological effects, and as it is a naturally occurring substance, hyaluronic acid is free of immunogenic activity, and is a non-toxic and non-irritating substance.

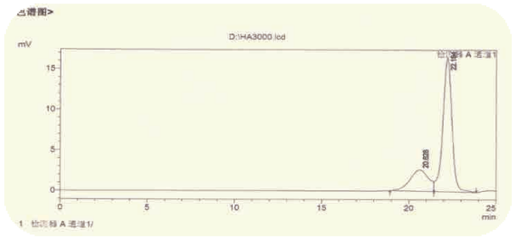
## AquaJuve™ Brings You…

### Precise Molecular Weight Control




GPC Calculation of AquaJuve CE, Mw/Mn=1.93673

### High Purity




Peak Area of AquaJuve 3500 is 197494.

# Cosmetic AquaJuve™ Hyaluronic Acid

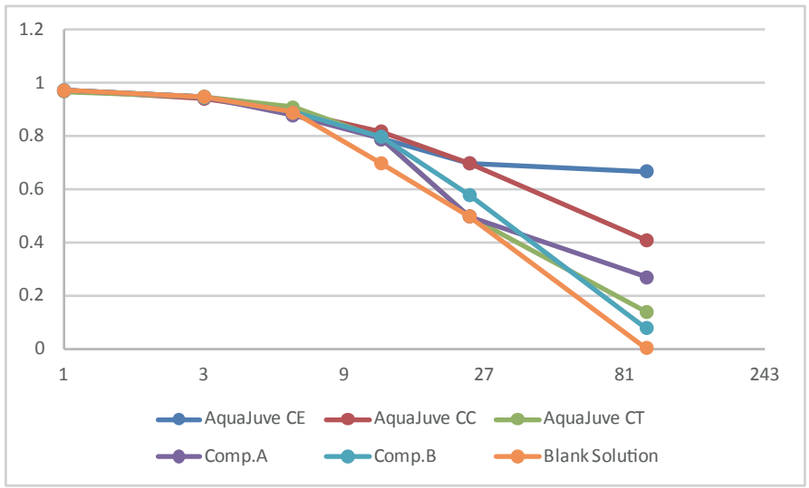
| AquaJuve | Molecular Weight |
|---|---|
| AquaJuve CT | 0.8-1.0 MDa |
| AquaJuve CC | 1.0-1.35 MDa |
| AquaJuve CE | 1.2-2.0 MDa |
| AquaJuve HCE | 1.7-2.0 MDa |
| AquaJuve Q | 1% aqueous solution |

| | |
|---|---|
| Origin | biotechnological processing |
| Appearance | white powder * |
| Appearance of 1% Aqueous Solution | clear, colorless solution |
| Sodium Hyaluronate ( dry basis ) | 90-105% |
| Glucuronic Acid | ≥ 45.0% ** |
| Protein | ≤ 0.1% |
| Loss on Drying | ≤ 10.0% |
| Heavy Metal ( as Pb ) | ≤ 20ppm |
| Arsenic | ≤ 2ppm |

*: AquaJuve Q appearance is clear, colorless solution.
**: AquaJuve CT Glucuronic Acid content is ≥ 44.0%

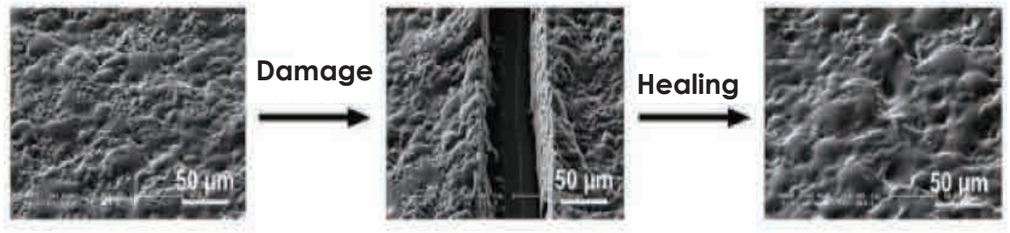
## Excellent Moisture Retention

AquaJuve series products have outstanding moisture retention. We made 1% solution from different Sodium Hyaluronate, then weight the loose of water after different hours to judge the moisture retention of AquaJuve.

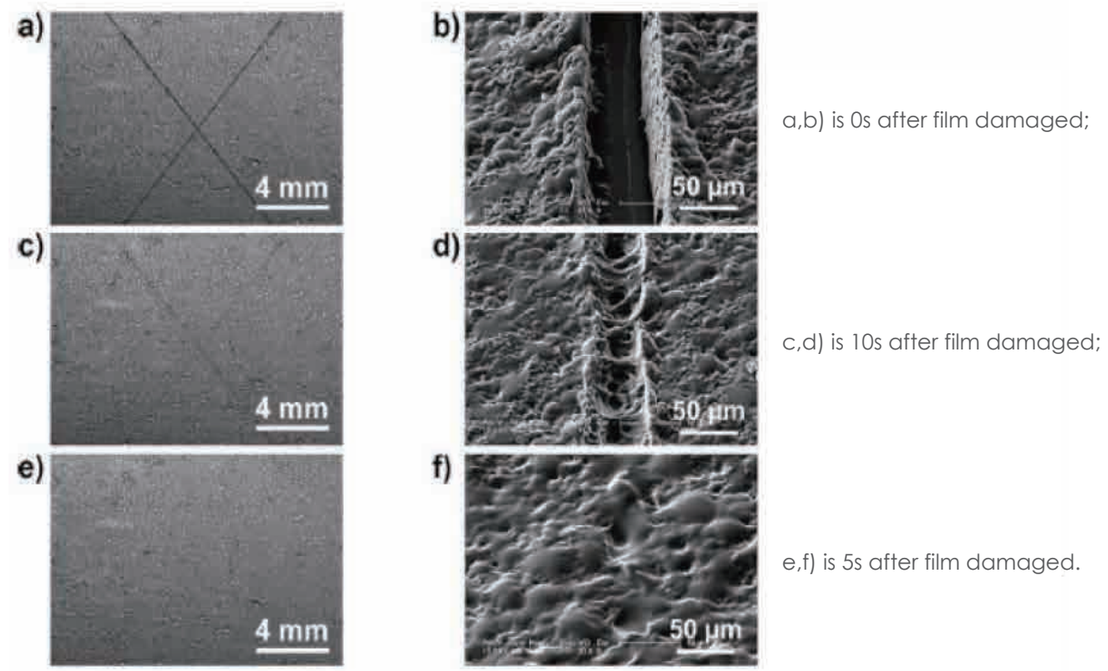



## Film Forming and Self Healing

AquaJuve is able to form compact but ventilate film to prevent lose of skin moisture. The film formed by AquaJuve high purity HA, is proved to be self healed soon after damaged by environmental break. Film formed by AquaJuve CT




The details of self-healing process. ( under the 4mm and 50um electronic speculum )




a,b) is 0s after film damaged;

c,d) is 10s after film damaged;

e,f) is 5s after film damaged.

# Nutraceutical AquaJuve™ Hyaluronic Acid

| | |
|---|---|
| Grade | AquaJuve FD |
| Appearance | white powder |
| Molecular Weight | 0.8-1.2 MDa |
| Origin | biotechnological processing |
| Appearance of 1% Aqueous Solution | clear, colorless solution |
| Sodium Hyaluronate ( dry basis ) | 90-105% |
| Glucuronic Acid | ≥ 45.0% |
| Protein | ≤ 0.1% |
| Loss on Drying | ≤ 10.0% |
| Heavy Metal ( as Pb ) | ≤ 20ppm |
| Arsenic | ≤ 2ppm |

**SOURCE**

- Fermentation, Streptococcus. Zooepidemicus bacterial strain
- Non-GMO
- Non-animal materials used during the manufacturing process

**TOXICOLOGY**

- Non-irritating
- Non-cytotoxic
- Non-phototoxic

**SOLUBILITY**

- Fully soluble in water.
- Insoluble in non-water miscible solvents.

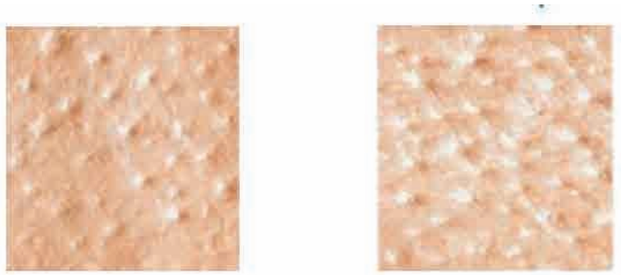
## Nutritional Value of AquaJuve™ FD

Unit of Measurement, 1 gram.

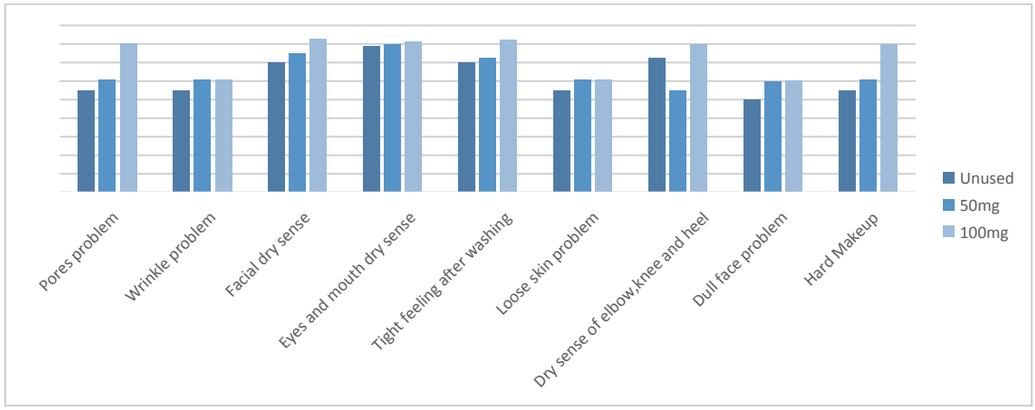
| | | | |
|---|---|---|---|
| **Calories** | 0 | **Sodium** | 80 mg |
| **Total Fat** | 0 g | **Potassium** | 0 mg |
| Saturated | 0 g | **Total Carbs** | 0 g |
| Polyunsaturated | 0 g | **Dietary Fiber** | 0 g |
| Monounsaturated | 0 g | **Sugars** | 0 g |
| Trans | 0 g | **Protein** | 0 g |
| **Cholesterol** | 0 mg | | |
| **Vitamin A** | 0% | **Calcium** | 0% |
| **Vitamin C** | 0% | **Iron** | 0% |

*Percent Daily Values are based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

We chose 30 women with age of 25-35 years old randomly, and divided them into 3 groups ( 10 women per group ) in accordance with the average age.
Three groups take **placebo** ( food grade hydroxyethyl cellulose ether ), **AquaJuve FD 50mmg**, **AquaJuve FD 100mmg** on 12 o'clock everyday respectively during 29 days. We tested the Skin moisture improvement through the digital monitor within 3 hours after the last taking action was completed.




Picture 1 Improve on Skin Texture by intaking AquaJuve™ FD




The dry skin problems for most subjects, including their faces, mouths and eyes can be improved by oral taken hyaluronic acid AquaJuve FD. The moisture content and metabolism of skin can be also improved by oral hyaluronic acid AquaJuve FD, we can improve skin moisture, texture, elasticity and reduce wrinkles.

# Innovative forms AquaJuve™ Hyaluronic Acid

We can produce various derivatives and also forms of Hyaluronic acid. Discover the wide range of possibilities, which are able to meet even your most special demands.

**Ultra Low molecular weight HA**

**AquaJuve™ 3500**

**Customized HA**

**AquaJuve™ Plus**

**Compound HA**

**AquaJuve™ ECT**

## AquaJuve™ 3500

Gerally, hyaluronic acid has large molecular weight from 0.8-2.0 MDa. This feature leads to excellent film forming and moisture retention properties of HA in cosmetic, Nutraceutical and many other applications.

The innovative form AquaJuve 3500, with only 3,000-10,000 Da. This nano-size HA can be absorbed by skin much easier.

It can be well used in both cosmetic and food fields.

**Chemical Properties**

Physical Properties

Glucuronic Acid: ≥ 44.0%

HA content: 90-105%

**Applications**

Cosmetics ( milk, lotion tec)

Nutraceutical

**Physical Properties**

White Powder

Transparency: ≥ 99.5%

## Long lasting Moisturizing

20 Chinese Females with healthy skin condition are divided into two groups by random.
Each group has 10 volunteers.
Age from 28-36. 100% of them finalized the test.
After cleaning face, volunteers apply 0.2% AquaJuve CE and AquaJuve 3500 solution on their cheeks and T-zones. Measure the moisture content of skin at cheeks and T-zones.
Record the data and calculate the average data.
Group 1 record the data by hour, total 8 hours.
Group 2 record the data by day, total 90 days.

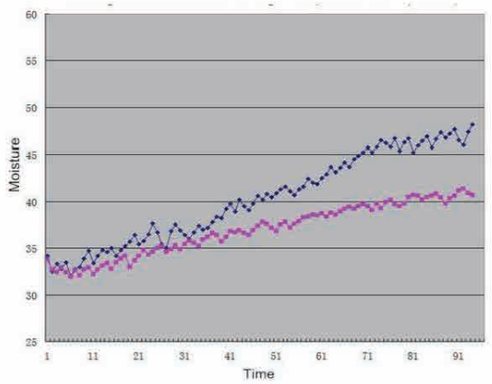
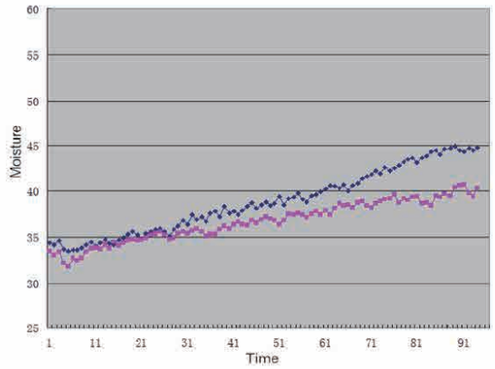



Diagram 2. Moisturizing Efficacy Comparison between AquaJuve CE and AquaJuve 3500 in 90 days ( Cheek )

Blue for AquaJuve 3500 while Pink for AquaJuve CE

Diagram 3. Moisturizing Efficacy Comparison between AquaJuve CE and AquaJuve 3500 in 90 days ( T-zone )

Blue for AquaJuve 3500 while Pink for AquaJuve CE




## Conclusion

*. Skin moisture content can be improved significantly by using AquaJuve CE and AquaJuve 3500.
*. AquaJuve CE has better performance on instant moisturizing efficacy.
*. AquaJuve 3500 has better performance on long time moisturizing efficacy.
*. It is recommended to used AquaJuve CE and AquaJuve 3500 together into formulations to impart with both instant and long time moisturizing efficacy.

## AquaJuve™ Plus

### Chemical Properties

Molecular Weight: 0.01-0.8 MDa

Customized

Glucuronic Acid: ≥ 44.0%

HA content: 90-105%

### Applications

Cosmetics ( milk, lotion tec)

Nutraceutical

### Physical Properties

White Powder

Transparency: ≥ 99.5%

## AquaJuve™ ETC

### Chemical Properties

Molecular Weight:  compound

Glucuronic Acid: ≥ 44.0%

HA content: 90-105%

### Applications

Cosmetics

( toner, lotion, cream )

### Physical Properties

White Powder

Transparency: ≥ 99.5%

# Wound Healing AquaJuve™ Hyaluronic Acid

AquaJuve ME can be used in bioactive dressing for infected wounds which delivers both an antimicrobial and biological effect in healing. Sizable dressing creates a gel on contact with the wound exudate and releases AquaJuve ME and active pharmaceutical ingredient. AquaJuve ME plays a key role in the tissue regeneration processes. This could brings advanced wound healing by incorporating AquaJuve ME based products in a simple and easy to use form, ideal for regular usage in a working hospital's routine.

### Chemical Properties

Molecular Weight:  1.0-2.0 MDa

Glucuronic Acid: ≥ 45.0%

Bacterial Endotoxin: ≤ 0.5EU/mg

### Applications

External Medical

Wound Healing

Private nursing

### Physical Properties

White Powder

Transparency: ≥ 99.5%

**Tips:**

Dissolution Method

HA has excellent compatibility. It can be added to almost all kinds of water-contained cosmetics. The higher the molecular weight and density are, the slower the dissolution is. It is recommended to heat while dissolving, and keep a concentration of 0.5~1.0%, heat up the water to 60-80℃ and then put into the powder of HA slowly with rapid stirring. Pay attention not to make it turn to solid because of its viscosity. Commonly, it takes 20-60 minutes to reach the complete dissolution.

In actual production, we advise customers to take another container and put HA into glycerin, propylene, or1.3 glycol butanediol of partial or full formula dosage. After agitating and immersing sufficiently, transfer in into the water phase tank and heat up slowly to make it dissolve completely.

# CATIONIC HYALURONIC ACID

**INCI Name**: Hydroxypropyltrimonium Hyalutonate

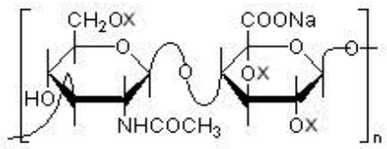
Hyaluronic Acid, with chemical name sodium hyaluronate, is recognized as best moisturizing factor in nature. Ordinary HA is anionic linear molecular weight and does not have conditioning efficacy in hair care fields.

NatiFlex HyaMate is innovative cationic hyaluronic acid. By using HA AquaJuve as backbone, cationic group is combined optimally by Joyvo's own technology. This make NatiFlex Series HA has remarkable moisturizing effect on hair, the moisturizing performance is enhanced in skin care as compared to using HA alone.

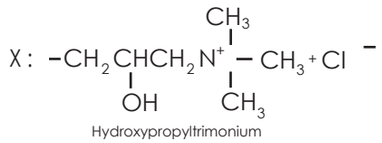
## How is Cationic HA work in hair care fields.

**Surface of the hair is usually charged negative.**

**NatiFlex HyaMate is charged positive.**




AquaJuve™




NatiFlex™ HyaMate

**NatiFlex HyaMate is presumed to adhere to the hair by ionic bond.**

## Typical Properties

| NatiFlex | Specifications |
|---|---|
| NatiFlex HyaMate | Powder |

| Items | Spesifications |
|---|---|
| Grade | NatiFlex HyaMate |
| Appearance | White to Light Yellowish powder |
| Identification | |
| (1) Reaction with CPC | Positive |
| (2) Sodium | Positive |
| (3) Glucuronic Acid | Positive |

**NatiFlex™ Hyaluronic Acid brings you**

- Has good synergy efficacy in shampoos and hair conditioners
- Enhance the water retention of hair
- Apply in cationic, nonionic and anionic systems
- Reduce irritation
- Adjust liquid viscosity
- Easy to use

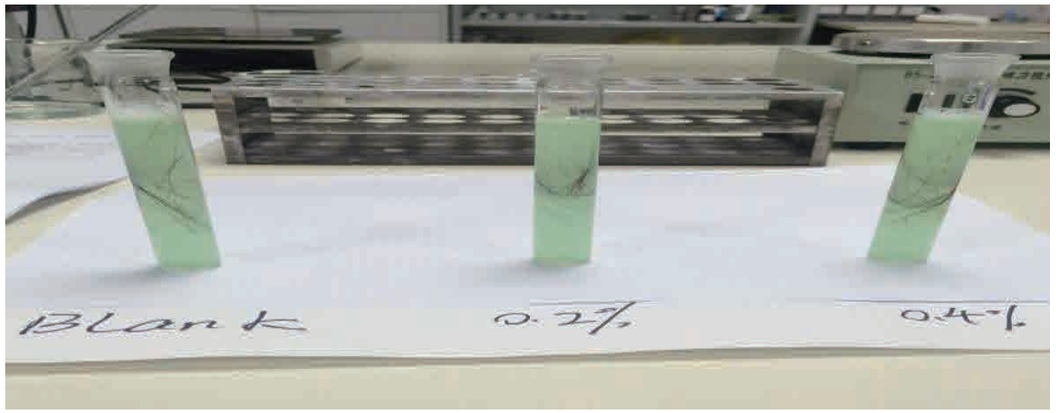
**Application:**

- Hair mist, Hair gel.
- Liquid hair treatment
- Shampoo, Conditioner
- Hair treatment, shower gel
- Hand cream, eye cream

**Dosage Recommendation:**

- NatiFlex HyaMate: 0.25-0.75%

## Adhesion Test of NatiFelx™ HyaMate



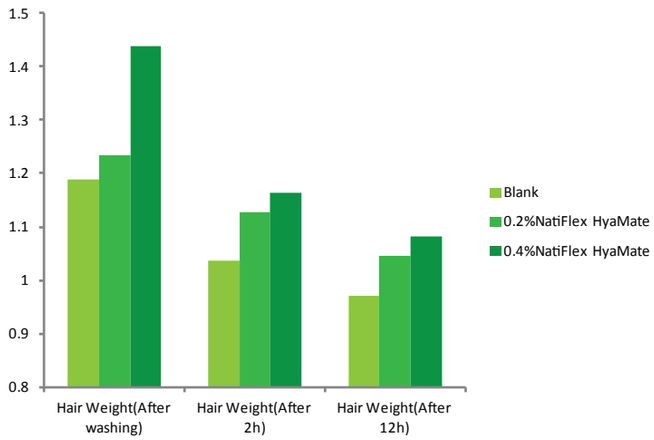

Blank shampoo

0.2% NatiFlex HyaMate shampoo

0.4% NatiFlex HyaMate shampoo

Add the same quality hair to three sample.
Soaking at 25℃ for 15 minutes.
Rinse with purified water at 25℃ 10 times, then into dryer.
Test hair mass data in different points.

| | Before washing | After washing | Water retention | 2h later | Water retention | 12h later | Water retention |
|---|---|---|---|---|---|---|---|
| Blank | 0.2651g | 0.3152g | 118.90% | 0.2751g | 103.77% | 0.2574g | 97.10% |
| 0.2% | 0.2303g | 0.2842g | 123.40% | 0.2597g | 112.76% | 0.2408g | 104.56% |
| 0.4% | 0.2761g | 0.3971g | 143.82% | 0.3211g | 116.30% | 0.2988g | 108.22% |




**Conclusion:** Moisture content of hair can be significantly improved by using shampoo with NatiFlex HyaMate. The moisturizing effect can be well kept after 12h. Moisturizing efficacy increases as per the dosage of NatiFlex HyaMate increases.

## Hair Smoothing Efficacy of NatiFlex™ HyaMate

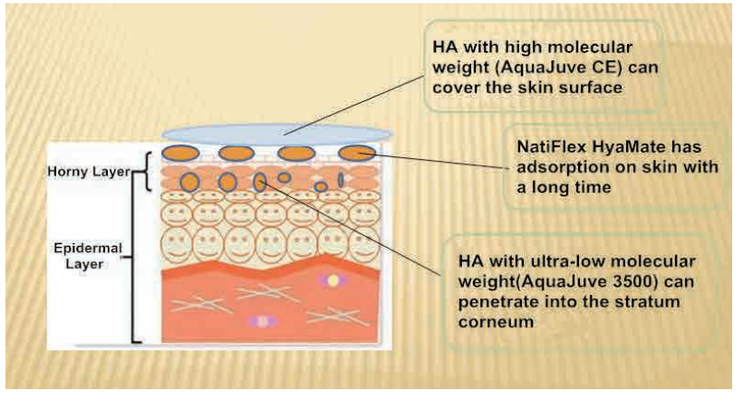
Choose three volunteers with similar hair structure. Use different shampoos every 2 days. The first use blank shampoo, the second uses shampoo with0.2% NatiFlex HyaMate, third usesshampoo with 0.4% NatiFlex HyaMate shampoo.

Combing ability was measured after shampooing. The results are as follows

| | Blank shampoo (gf-mm/g of hair) | 0.2%NatiFlex HyaMate (gf-mm/g of hair) | 0.4%NatiFlex HyaMate (gf-mm/g of hair) |
|---|---|---|---|
| A | 507 | 365 | 304 |
| B | 515 | 382 | 311 |
| C | 483 | 355 | 296 |
| Average | 502 | 367 | 304 |

**Conclusion:** Combing energy was greatly reduced by using shampoo with NatiFlex HyaMate. Hair gets much smooth as per the dosage of NatiFlex HyaMate increases.

## NatiFlex™ HyaMate in Skin Care




**Volunteers:** 6 Chinese women (aged 21 to 24), the moisture content of their hand skin is almost the same.

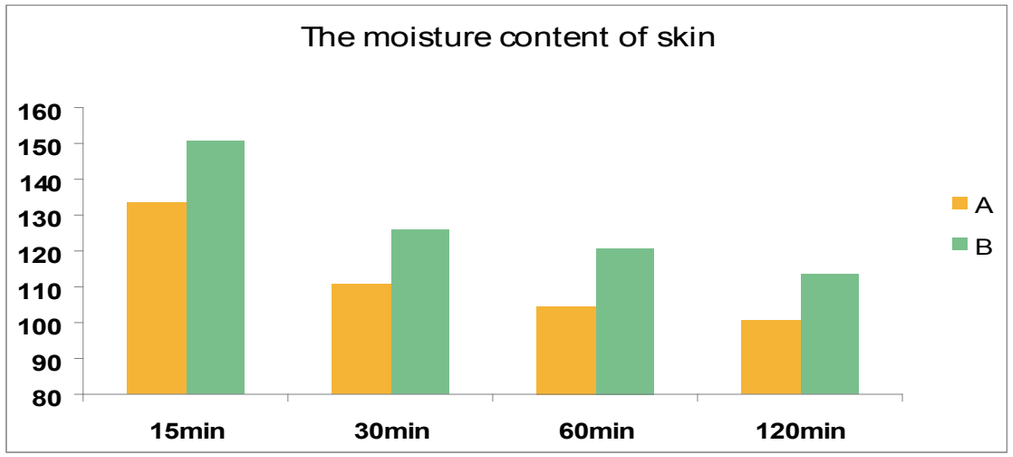
**Test method:** 6 volunteers join

One hand use Group A, Another hand use Group B

Take 0.5 ml from Group A and Group B on each volunteer's hands and smear homogeneously

Wash with water and wait for natural dry

Record the moisture contents during different time




**Group A:** 0.2% common hyaluronic acid

**Group B:** 0.15% common hyaluronic acid acid + 0.5% NatiFlex HyaMate

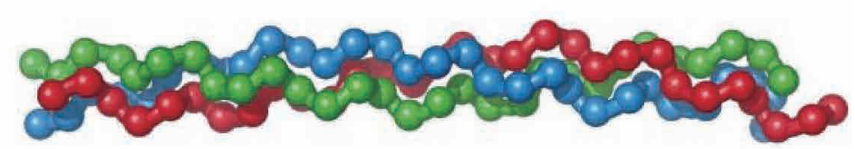
| | | Repair | Elasticit | Moisturizing | Skin Feeling | Elasticity | Smooth | Skin Barrier | Moisturizing |
|---|---|---|---|---|---|---|---|---|---|
| Hair Care | Trade Name | | | | | | | | |
| | AquaJuve CT | | | | | | | | ❄ |
| | AquaJuve CC | | | | ❄ | | | ❄ | ❄ |
| | AquaJuve CE | | | | | | | ❄❄ | ❄❄ |
| | AquaJuve HCE | | | | | | ❄❄ | ❄❄ | ❄❄ |
| | AquaJuve Q(Liquid) | | | | ❄ | | ❄ | ❄ | ❄ |
| | AquaJuve FD | | | | | ❄ | | | ❄ |
| | AquaJuve ECT | | | | ❄ | | ❄ | ❄ | ❄❄ |
| | AquaJuve Plus | | | | ❄ | ❄ | | | ❄ |
| | AquaJuve 3500 | ❄ | ❄ | ❄ | ❄ | ❄ | | | ❄❄ |
| | NatiFlex HyaMate | ❄ | ❄❄ | ❄❄ | | | | | |

# COLLAGEN

**INCI Name**: Collagen

**CAS NO.** : 92113-31-0

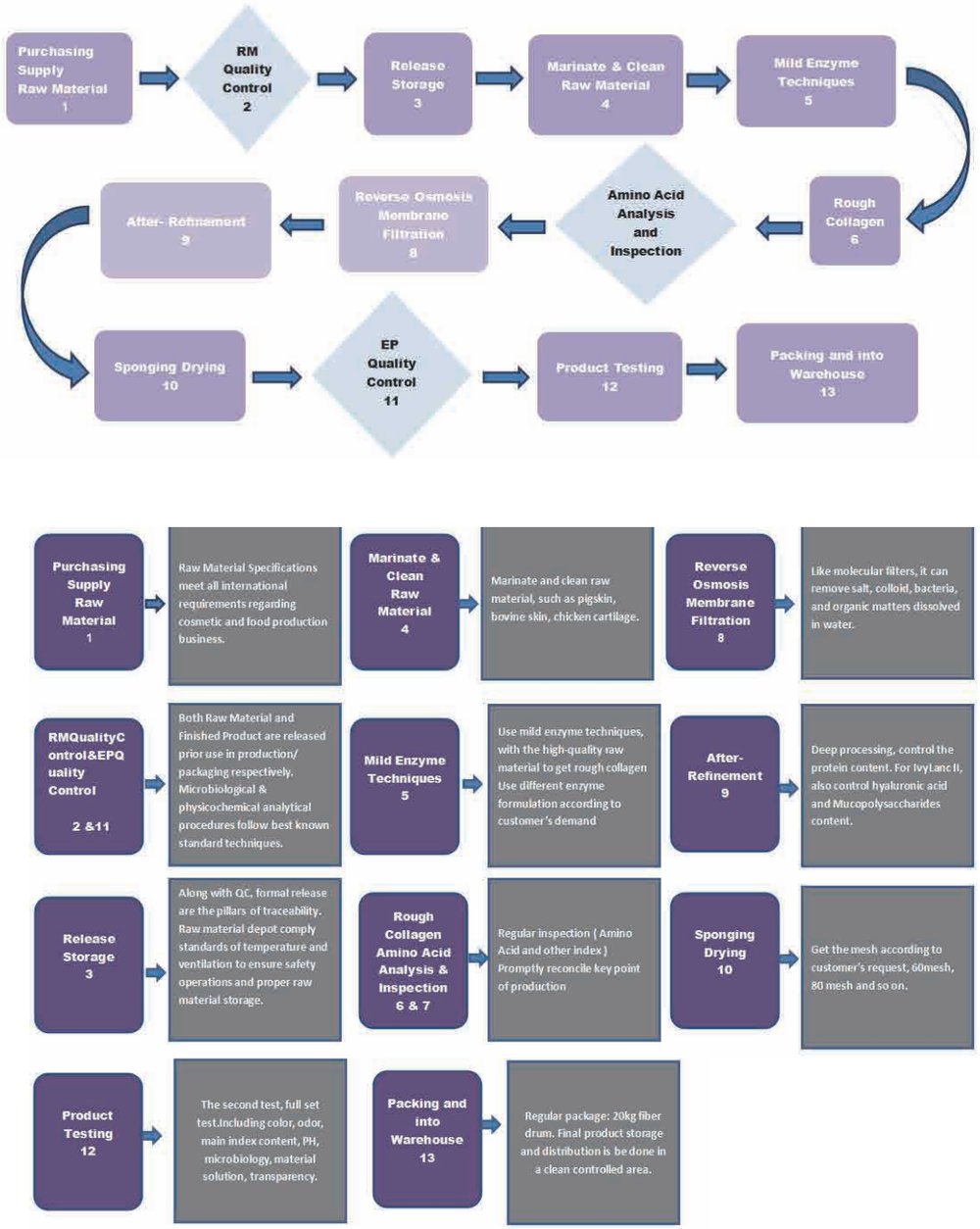
Collagen is the body's most important building block and it makes up approximately 30% of the proteins in our bodies. Collagen is a key structural protein that ensures the cohesion, elasticity and regeneration of all our connective tissues including skin, cartilage and bones. In essence, it is the 'glue' that holds everything together. It strengthens various body structures and the integrity of our skin.



## IvyLanc™ Family

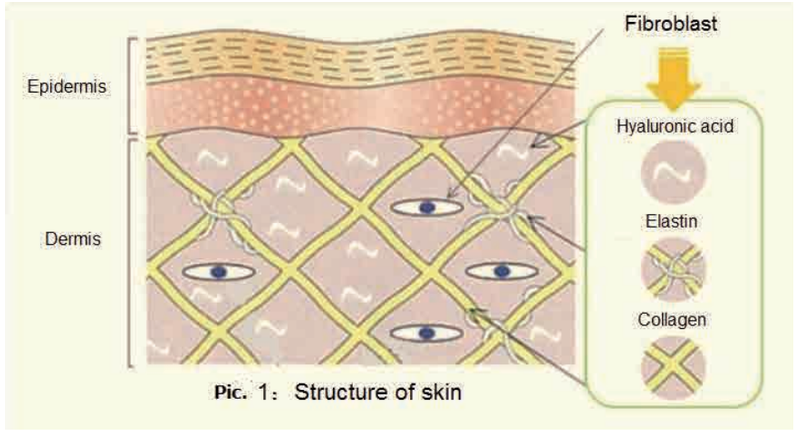
| IvyLanc | Source | Molecular Weight |
|---|---|---|
| IvyLanc F | Fish Skin | 2000-3500 |
| IvyLanc S | Fish Scale | 1500-2500 |
| IvyLanc 1000 | Fish Scale | 1000 |
| IvyLanc MF | Marine Fish | 2000-3500 |
| IvyLanc 1200B | Bovine Skin | 2000-4000 |
| IvyLanc 1200S | Bovine Skin | 2000-4000 |
| IvyLanc Ⅱ | Chicken Cartilage | --- |

## Advanced Production Technology

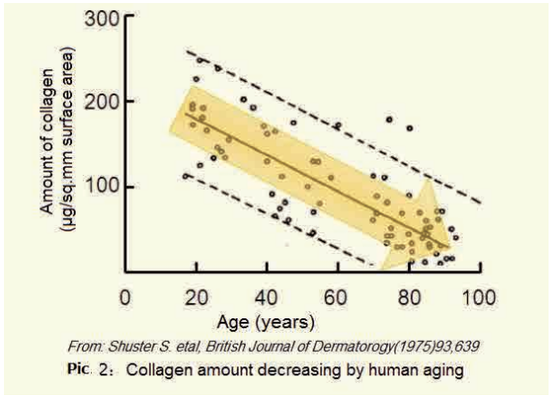


# Cosmetic IvyLanc™ Collagen

Generally speaking, skin is made of epidermis and dermis. Epidermis is important organ that exposing directly in daily environments. Dermis exists under epidermis, it is consisted by collagen, elastin, hyaluronic acid etc. Collagen imparts elasticity to skin, and hyaluronic acid is significant natural moisturizing factor.



Pic. 1: Structure of skin



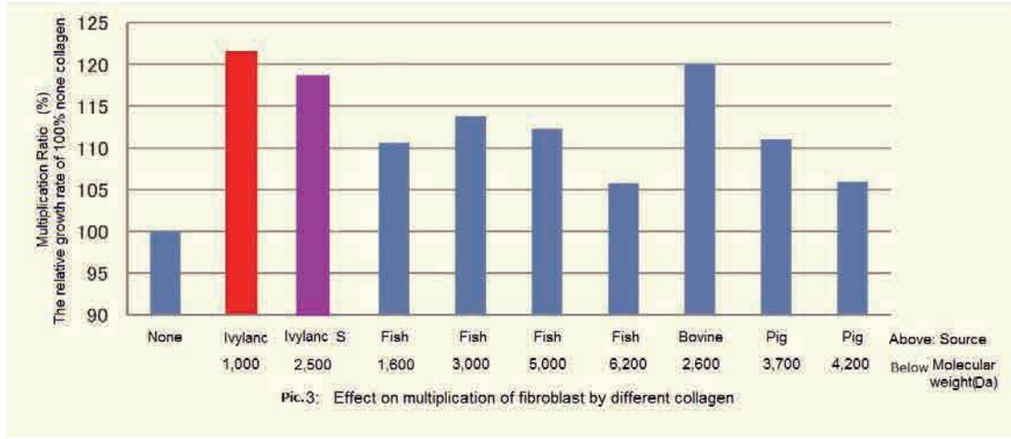
*From: Shuster S. etal, British Journal of Dermatorogy(1975)93,639*

Pic. 2: Collagen amount decreasing by human aging

Principle of above is the decrease of metabolism and synthetic function from collagen in skin.

The synthetic function of collagen is related with fibroblast in dermis. Total amount of firbroblast decrease by aging. Lifetime of fibroblast shortens by daily UV irradiation as well. Therefore, reduction of skin elasticity and moisture related tightly to decrease of fibroblast amount in dermis.

## IvyLanc™ collagen improves multiplication ability of Fibroblast significantly

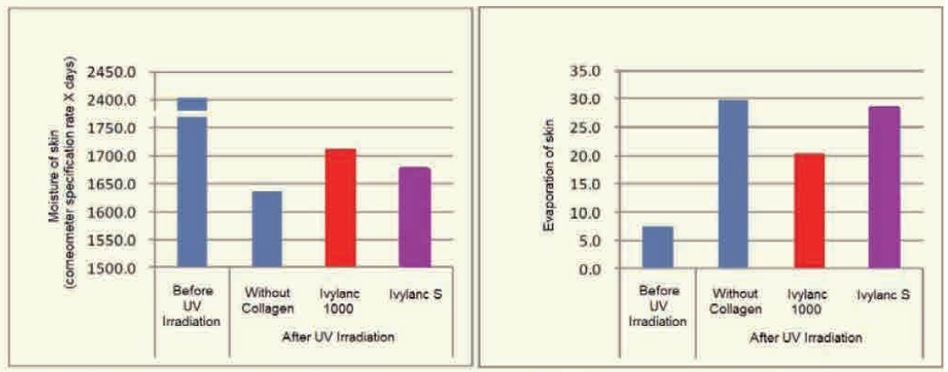


Pic.3: Effect on multiplication of fibroblast by different collagen

*Add 50ug/ml different collagen ( Different molecular weight, source and from different suppliers in market ) into culture solution of Fibroblast ( Natural human dermal fibroblast, NHDF ).*

We can find all kinds of collagen are able to improve multiplication ability of Fibroblast, and we can see IvyLanc 1000 and IvyLanc S play the best performance among tested collagen.

## IvyLanc™ Collagen improves function of UV damaged skin significantly



Pic. 4: Collagen can control the reduction of moisture in skin

Pic. 5: Collagen can control the evaporation of moisture in skin

*Feed IvyLanc 1000 and another fish scale collagen with molecular weight 1000 Da by 500mg/kg BW to UV irradiated and skin damaged mice and we can observe the skin improve results.*

It shows IvyLanc 1000 imparts best effect to damaged skin by significant controlling reduction of skin moisture and evaporation of skin moisture.

# Food and Joint Health IvyLanc™ Collagen

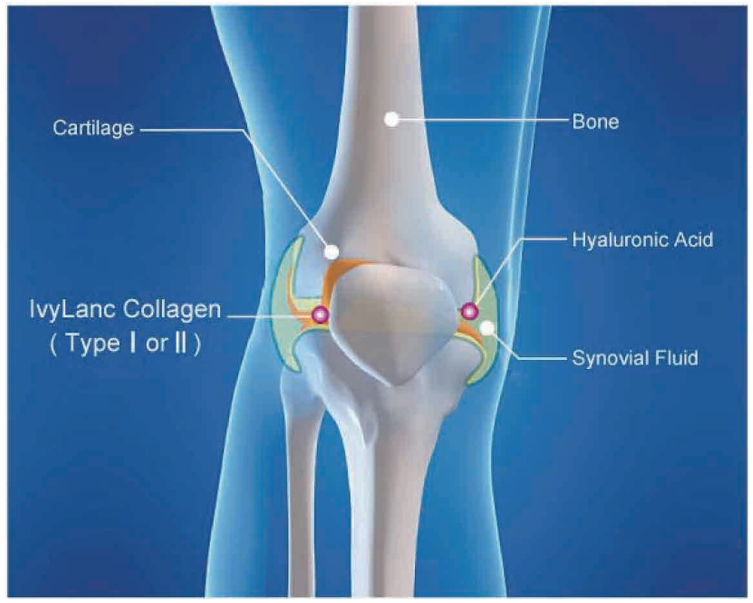
Nutrition plays a key role as athletes' prepare to reach optimum performance levels and the essential role of proteins is also well known to recreational athletes and active consumers.

| Amino acids ( % of protein ) | IvyLancTM average value |
|---|---|
| Alanine | 7 |
| Arginine | 6 |
| Glutamic acid | 11 |
| Glycine | 24 |
| Hydroxyproline | 12 |
| Proline | 13 |

**IvyLanc collagen deliver numerous health and nutritional benefits to athletes both during and after exercise.**

- **Aiding muscular contraction**
- **Muscle restoration**
- **Provide energy for performance**
- **Weight management**

Type II collagen composed by three $a_1$ (II) chains. The fiber diameter formed by Type II collagen is finer in cartilage matrix, these fine fibril formation in cartilage fine network structure.




*10 grams of collagen hydrolysate per day has been shown to be an effective dosage in clinical trials IvyLanc II ( type II collagen ) is more effective for jiont health because it contains hyaluronic acid natively.*


*1. Moskowitz RW. Role of collagen Hydrolysate in Bone and Joint Disease. Seminars in Arthritis and Rheumatism, 30( 2 ): October, 2000: pp 87-99
2. Bello AE, Oesser S. Collagen hydrolysate for the treatment of osteoarthritis and other joint disorders: a review of the literature. Curr Med Res Opin. 2006 Nov;22(11): 2221-32
3.Seeligmuller K, Happel HK. Can a mixture of gelatin and L-cystine stimulate proteoglycan synthesis? Therapiewoche 1989;39: 3153-57.


## Nutritional Value of IvyLanc™ II Collagen

| | |
|---|---|
| Calories | 295-350 Kcal |
| Total Fat | ≤1.0 g |
| Mineral Salts | ≤8.0 g |
| Total Carbohydrates | 24.0-30.0 g |
| ( Sugars in carbohydrates ) | 9.0-10.0 |
| Protein | ≥60.0 g |
| Fiber | ≤0.2 g |
| Water | ≤12.0 |

Unit of Measurement, 100 gram

# Hair care IvyLanc™ Collagen

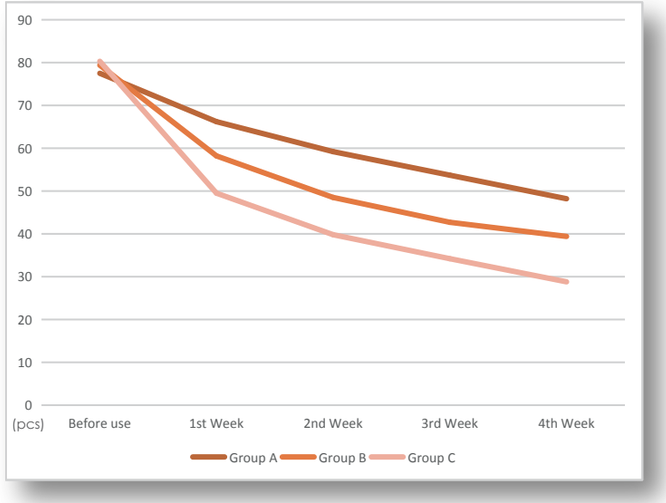
Enough  nutrition provide for subcutaneous tissue scalp, which is a main reason to create healthy hair. And the collagen located in dermis, as the source of nutritional supplementation, to provide nutrition for epidermal layer and epidermal appendage.
As the hair protective layer, hair cuticle is a very fragile tissue and it could get damaged when it gets rubbed or heated, which cause the intimal collagen gets break down.
Thus collagen can be used in cosmetic and hair care fields.

12 Chinese female volunteers (24 to 43 year old ), all volunteers' hair are the same quality.
Divide 12 volunteers into 3 groups.
Group A use blank shampoo, group B use shampoo with 1.0% IvyLanc S, group C use shampoo with 2.0% IvyLanc S.
Each group test lasts 4 weeks, every Tuesday, Thursday and Saturday use once.
And test the hair data in Joyvo Lab every Sunday morning.

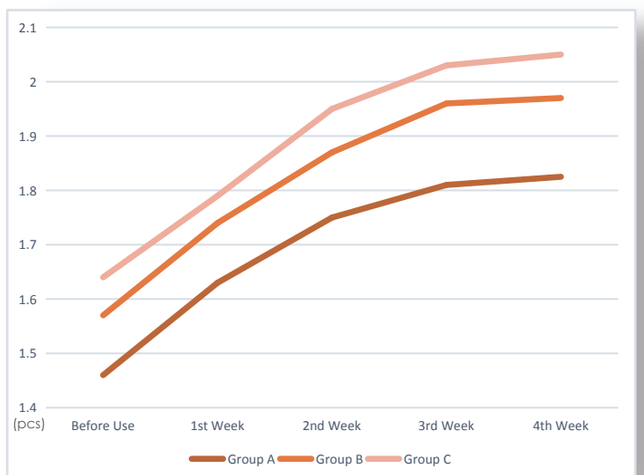
### Split Hair Average Data Record for Three Groups

| Volunteers | Before Use (pcs) | 1st Week (pcs) | 2nd Week (pcs) | 3rd Week (pcs) | 4th Week (pcs) |
|---|---|---|---|---|---|
| Group A | 77.5 | 66.2 | 59.2 | 53.7 | 48.2 |
| Group B | 79.4 | 58.2 | 48.5 | 42.7 | 38.4 |
| Group C | 80.3 | 49.5 | 39.8 | 34.2 | 28.8 |

### Split Hair Average Data Comparison



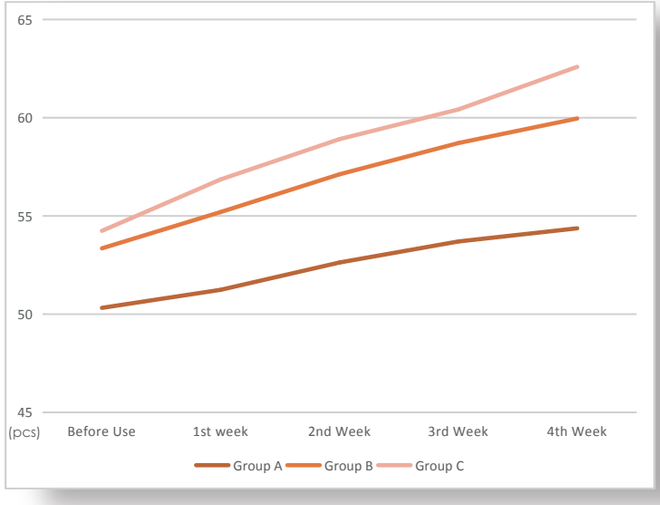

### Anti-break strength average data record and analysis




Thus the shampoo with IvyLanc S can obviously improve hair tenacity, and compared to shampoo with 1.0% IvyLanc S, the improvement effect of shampoo with 2.0% IvyLanc S is more distinct.

### Tensile strength average data record and analysis

Thus the shampoo with IvyLanc S can obviously improve hair elasticity, and compared to shampoo with 1.0% IvyLanc S, the improvement effect of shampoo with 2.0% IvyLanc S is more distinct.

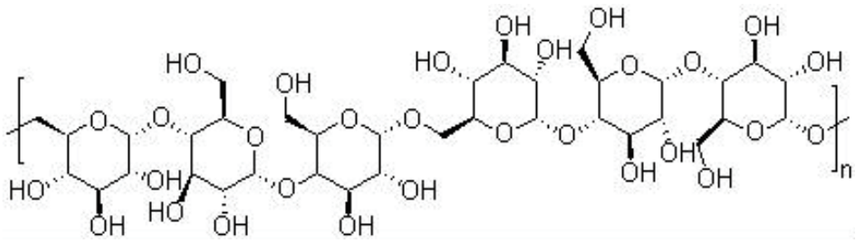


# Pullulan

**INCI Name**: Pullulan

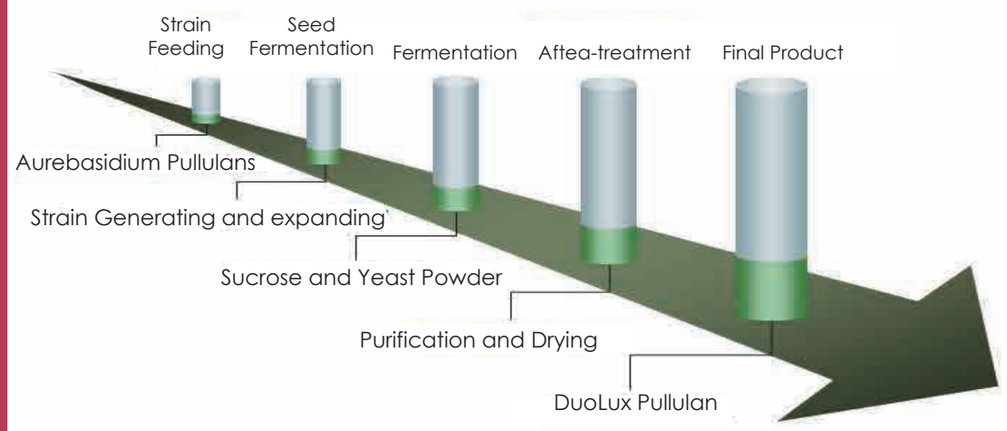
**CAS NO.** : 9057-02-7

**Chemical Name**: Pullulan



Pullulan is made of Aureobasidium pullulans by fermentation, it has various applications in cosmetics and food industry. It is recommended to be used in skin care, skin clean, diet control and food mouthfee improvement.

## Production Process

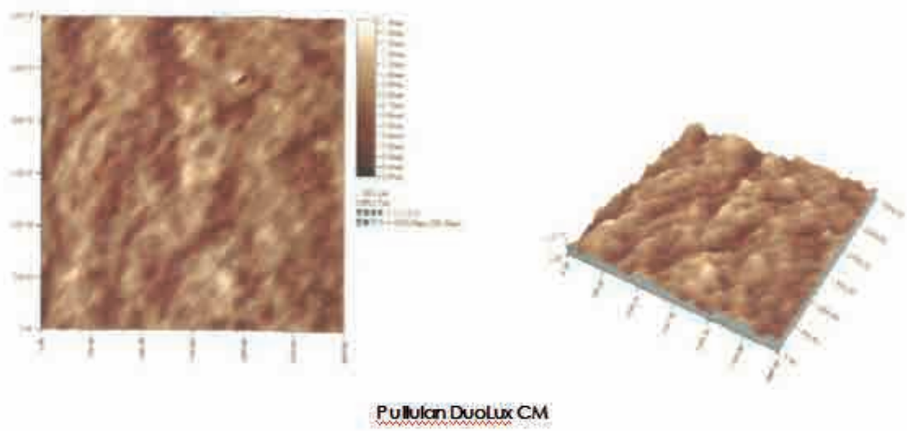



## DuoLux™ Technical Data

| Item | DuoLux™ CM | DuoLux™ FD |
|---|---|---|
| Appearance | White or slight yellowish | White or slight yellowish |
| Pullulan (Dry basis) | >90% | >90% |
| Viscosity (10 wt%,in 30°C, cst) | 15-180 | 15-180 |
| Mono-, Di- and Oligosaccharides | ≤10.0% | ≤10.0% |
| Total Nitrogen | ≤0.05% | ≤0.05% |
| pH (10% aqueous solution) | 5.0-7.0 | 5.0-7.0 |
| Loss on drying | ≤6.0% | ≤6.0% |
| Ash | ≤5.0% | ≤5.0% |

## Cosmetic Grade Pullulan- DuoLux™ CM

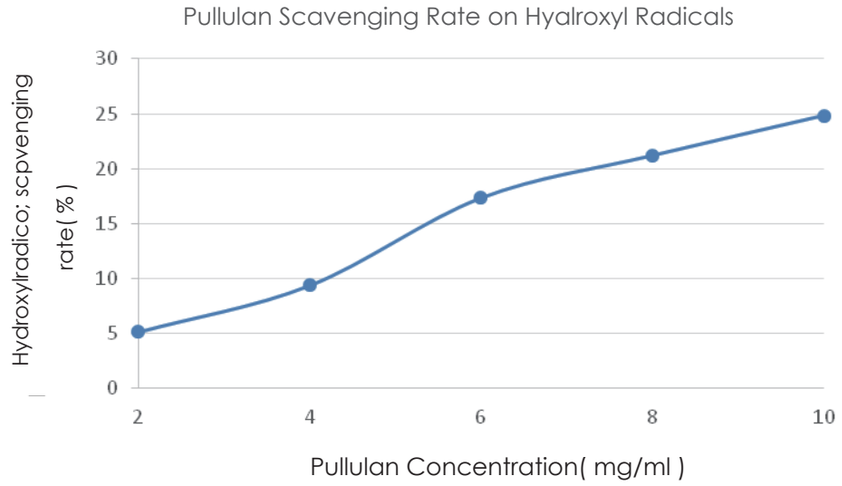
DuoLux™ CM- Excellent film forming Property




Pullulan DuoLux CM has regular and compact nano peaks appearance, no obvious pores can be found. The average roughness is low to 0.1 46 nm which showed that film surface is smooth.

## DuoLux™ CM - Antioxidant Capacity

Hydroxyl radical (-OH) is a kind of reactive oxygen, with strong oxidizing ability, by testing the ability of pullulan on scavenging hydroxyl radicals to determine its antioxidant capacity.




Pullulan DuoLux CM, its scavenging ability of hydroxyl radicals increases with increasing concentration. It provides proof for pullulan applications in food and cosmetics as antioxidant agent.

## DuoLux™ CM- Efficacy Validation

**Number of Volunteers:** 45 Chinese women with facial symptoms like excess oil on face, large pores, blackhead, wrinkles, spots, dark skin.

**Age range:** 25-35 years' old

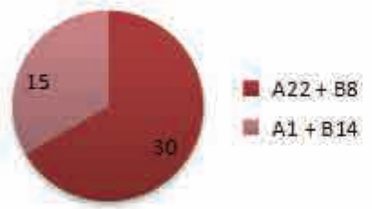
**Sample:** Vitamin C masks with 2% Pullulan,
Ordinary Vitamin masks (without Pullulan)

**Test duration:** 20 days. July 02-21, 2014

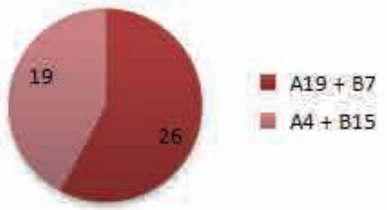
Total 45 volunteers finished the whole test.

**Test method:** Divide volunteers into two groups, A group (23 out of 23 finished) use Vitamin C masks with Pullulan, B group (22 out of 22 finished) use ordinary Vitamin masks.

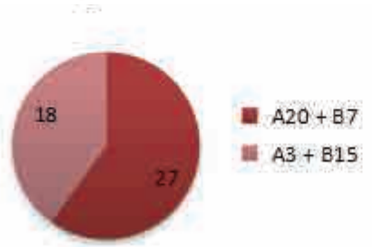
### Instant Wrinkles Reduction



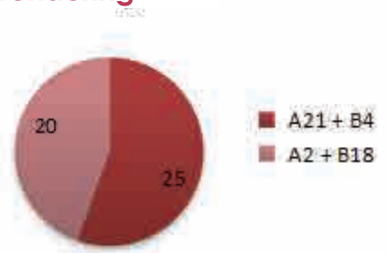

### Pores Refining




### Whitening




### Skin Tendering




From the above charts, A Group gets obvious skin improvements. We conclude Pullulan has positive efficacy on skin texture and facial texture of volunteers.

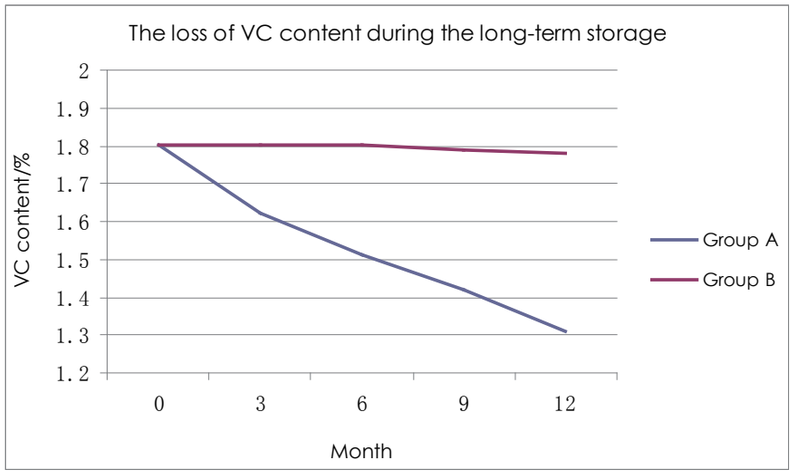
# Food Grade Pullulan- DuoLux™ FD

According to its excellent film forming ability, and combine with its safety and water solubility to apply in food as coating agent and preservative agent.

## DuoLux™ FD – Preservative Agent

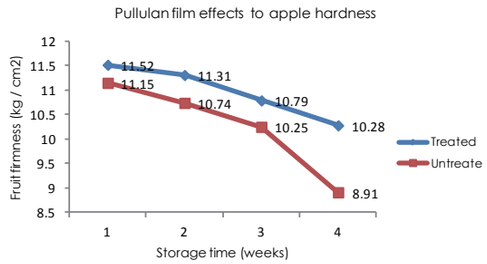
According to its excellent film forming ability, 1% pullulan solution can be dried to give a clear, odorless, flexible, stable, high strength film, and the film has a super gas barrier properties and oil resistance, therefore pullulan has an important role in food preservation.

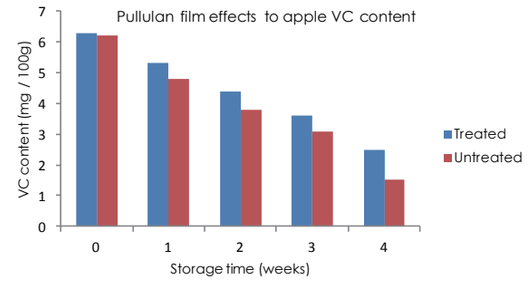
### Apply in VC Candy




Candy added pullulan as gel forming agent stored for 12 months and the index is no change, while candy without pullulan continue to loss VC during storage.

### Apply in Apple



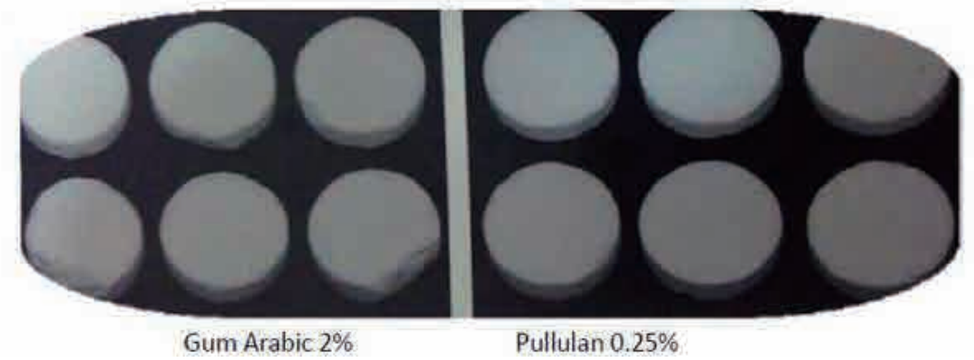




According to the above charts, its preservation effect in the fresh fruit is obvious, no environmental pollution.

## DuoLux™ FD – Coating Agent

Pullulan excellent film formation also makes it has excellent adhesion, which makes the finished product more complete and polished appearance, but also improve the mechanical strength of the product.

### Apply in Tablet




As a coating agent, pullulan provide effectiveness on protecting tablet completeness.