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3-O-ethyl ascorbic acid

- ★ **Inhibit the activity of Tyrosinase, prevent the synthesis of melanin**
- ★ **Accelerate the synthesis of collagen, improve the luster of skin**
- ★ **Strong antioxidation, eliminate the Free radical in body**
- ★ **Resist the inflammation of skin, inhibit the bacteria**
- ★ **Possess the structure of lipophilic and hydrophilic**
- ★ **Excellent stability of light, heat, acid, alkali, salt and oxygen**



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0. Structure Character

Chemical Name:	3-O-Ethyl Ascorbyl Ether
English Name:	3-O-Ethyl Ascorbyl Ether
INCI Name:	Ethyl Ascorbic Acid
Molecular Weight:	204.18
Molecular Formula:	$C_8H_{12}O_6$
CAS No.:	86404-04-8
Chemical Structure:	

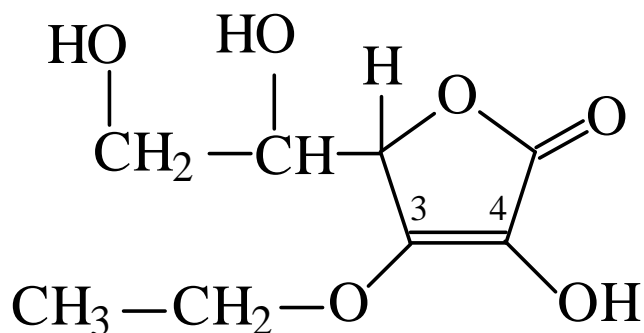


Fig.1 The structure of 3-O-ethyl ascorbic acid



1. Effectivity

3-O-ethyl ascorbic acid is an ethered derivative of ascorbic acid, the most excellent derivative of ascorbic acid so far. It is very stable in chemical structure, a real stable and discolored derivative of ascorbic acid, but also it can enter into skin and be metabolized by body as ascorbic acid. So its effect is better than pure ascorbic acid. 3-O-ethyl ascorbic acid is a unique lipophilic and hydrophilic material, easily used in cosmetic formulation. The most important is that 3-O-ethyl ascorbic acid can easily enter into dermis and play biological effect, while pure ascorbic acid almost does not enter into dermis. 3-O-ethyl ascorbic acid is an excellent choice for cosmetic chemists.

The character of 3-O-ethyl ascorbic acid:

- Excellent whitening effect: inhibit the activity of Tyrosinase by act on Cu^{2+} , prevent the synthesis of melanin ($\geq 2\%$)
- High antioxidation
- Stable derivative of ascorbic acid
- Lipophilic and hydrophilic structure
- Anti-inflammation, inhibit the growth of bacteria
- Improve the complexion, enhance the elasticity of skin.
- Repair skin cells, accelerate the synthesis of collagen.

1.1 Whitening effect:

Generally speaking, ascorbic acid can inhibit the synthesis of melanin. But the effect of direct using ascorbic acid to skin is very bad. Clinical tests of human and animal prove: cosmetic product containing 2% can improve the complexion and whiten the skin. The mechanism is:

1.1.1 Action one: deoxidize the oxidized jet black melanin into tint melanin

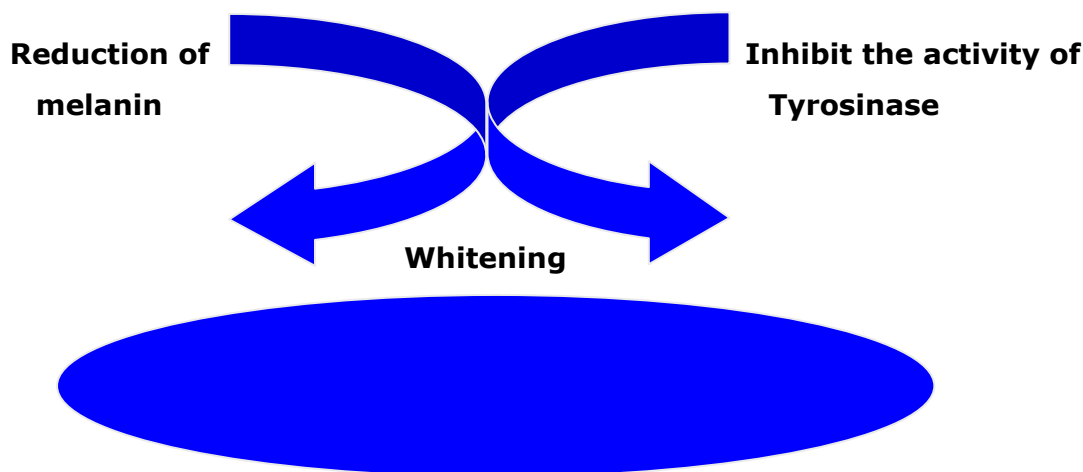
1.1.2 Action two: inhibit the activity of Tyrosinase, prevent the synthesis of melanin



Reason: act with coenzyme Cu^{2+} and weaken the activity of Tyrosinase, avoid the formation of melanin

Table1 Inhibit the activity of Tyrosinase

	0.1%	0.5%	1.0%
Ascorbic acid	96.7%	96.7%	97.6%
3-O-ethyl ascorbic acid	40.5%	89.4%	95.7%
Magnesium ascorbyl phosphate	0%	4.9%	6.1%



1.2 The synthesis of collagen

3-O-ethyl ascorbic acid can repair the activity of collagen (repair the structure and synthesis), improve the formation of skin cell and collagen according to the ratio of metabolic consumption. Its activity is similar to ascorbic acid phosphate derivative.

1.3 Antioxidation

1.3.1 antioxidation for oil

Cosmetic products contain plentiful oil, so they are easily oxidized by UV radiation, high temperature and humid atmosphere. When overdue or improperly stored, these products can be irritant to skin. Therefore, cosmetic manufacturers usually add BHT, BHA and Tocopherol, etc. But these antioxidants are oil soluble and not easily metabolized by body. 3-O-ethyl ascorbic acid is a high effective lipophilic and hydrophilic antioxidant, it can decrease the occurrence of oil oxidation, and prevent cosmetics deteriorate.



Table2 Inhibit the oxidation of oleic acid

Ingredient	Concentration(mmol)	Absorbency change		Inhibit ratio (%)
Blank		0.029	0.02	-
3-O-ethyl ascorbic acid	0.05	< 0.002		>93
	0.01	0.022	0.003	24
Tocopherol	0.05	< 0.002		>93
	0.01	< 0.002		>93
	0.001	0.011	0.003	62
Sulfide	10 g/ml	<0.002		>93
Catalase	10 g/ml	0.017	0.005	41

We determine the antioxidation of 3-O-ethyl ascorbic acid for oleic acid by determining the formation of active oxygen. Results: 0.05mmol/L 3-O-ethyl ascorbic acid can completely inhibit oxidation action of 1/100mol oleic acid (5.0mmol), at the same time, 0.01mmol/L tocopherol only can inhibit oxidation action of 1/500mol oleic acid. Therefore, the antioxidation ability of 3-O-ethyl ascorbic acid is 5 times more than tocopherol. We add 3-O-ethyl ascorbic acid, BHT, V_E to cotton seed oil, soybean oil, then determine the oxidation value.

Table3 Inhibit the oxidation cotton seed oil (100°C, mg/kg)

	Dose (%)	Time(hour)			
		9	12	15	18
Blank		34.2	48.5	71.6	100.3
3-O-ethyl ascorbic acid	0.005	26.5	41.0	58.5	85.5
	0.02	25.0	37.5	53.8	77.3
BHT	0.02	23.0	32.7	44.7	61.3
Tocopherol	0.02	29.5	55.4	79.2	116.1



Table4 the peroxidation value of Soybean oil (100°C, 23minute, mg/kg)

	Dose of Volume (%)	Time (hour)				Absorbency
		6	9	12	15	
Blank		24.8	43.7	73.0	113.9	0.109
3-O-ethyl ascorbic acid	0.02	18.9	31.1	49.5	77.1	0.260
	0.06	18.8	31.7	48.6	75.7	0.093
BHT	0.02	12.2	22.5	36.5	56.7	0.423
Tocopherol	0.02	25.6	48.9	77.4	91.2	0.092

Table5 the antioxidation in oil/water phase (mg/kg)

	Dose (%)	Time (hour)			
		3	6	9	12
Blank		16.4	40.9	79.1	135.6
3-O-ethyl ascorbic acid	2.0	11.7	25.9	40.0	73.6

1.3.2 The antioxidation in oil/water phase

Add 2% 3-O-ethyl ascorbic acid into water and soybean oil, in breathe 100°C atmosphere in order to oxidize oil and determine the change of value. (See table5)

1.3.3 The antioxidation for ethyl oleic acid ester compound

We add 3-O-ethyl ascorbic acid into cosmetic cream containing 15% ethyl oleic acid ester, concentration 0, 0.1, 0.5, 1.0, 3.0, 5.0. Then plentifully oxidize at 60°C, determine the peroxidation value by TBA test. Results: when the concentration of 3-O-ethyl ascorbic acid is more than 1%, it has very strong antioxidation effect.



1.3.4 The decrease of DPPH

We determine the decrease of DPPH for 3-O-ethyl ascorbic acid, magnesium, ascorbyl phosphate and BHT. Result: 3-O-ethyl ascorbic acid can decrease DPPH to 70%, BHT can decrease DPPH to 89.4%.

Table6 the DPPH decrease of 3-O-ethyl ascorbic acid and BHT

Ingredient	Decrement (%)
3-O-ethyl ascorbic acid	30%
BHT	10.6%
MAP	0.0

1.3.5 The reaction of iron ion

We determine the formation of compound by determining the decrease degree of iron ion. Result: 3-O-ethyl ascorbic acid and Tocopherol can decrease iron ion immediately, but 3-O-ethyl ascorbic acid is less than tocopherol.

Table7 the reaction of iron ion

Ingredient	Reaction Degree (%)
3-O-ethyl ascorbic acid	20
Ascorbic acid	99
Tocopherol	87

1.4 Anti-inflammation

3-O-ethyl ascorbic acid has strong anti-inflammation effect. Test proves: 3-O-ethyl ascorbic acid inhibits the formation of edema.

1.5 Transportation to dermis

Because of the instability and water solubility, ascorbic acid can't be absorbed by body. On the other wind, 3-O-ethyl ascorbic acid is stable, lipophilic and hydrophilic, so it can easily be absorbed by skin and transported to dermis.



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2. Safety

In 1997, Korean and Japanese authorize it as cosmetic ingredient.

In 2001, Korea FDA authorizes it as cosmetic functional ingredient. (KFDA No.: 2001-15, ethyl ascorbic acid, 2%)

2.1 Toxicity

We compare the disposed cell by 3-O-ethyl ascorbic acid and comparative cell, test prove 3-O-ethyl ascorbic acid is safe.

2.2 Epidermis irritation test

Test object: 6 Japanese white rabbit. We shave two 3×10cm area on test rabbit back, divide the area into two apartments. Lay 2.5×2.5cm cotton tray into 0.5mol/L, 20% 3-O-ethyl ascorbic acid solution, then lay it on the test area for 24 hours, meanwhile, lay comparative salt solution on blank area for 24 hours, observe and register. Result: 3-O-ethyl ascorbic acid can not bring redness, edema and any skin irritation.

2.3 Eye irritation test

We drop 0.1ml 20% 3-O-ethyl ascorbic acid solution into 6 Japanese rabbit right eye, after test 1, 24, 48, 72 hours, determine cornea, conjunctiva, iris and eyelid. Result: 3-O-ethyl ascorbic acid is safe for eye.

3. Analytical Data

3.1 General data

Check Item	Unit	Standard prescript	Method
Appearance		White to light yellow powder	Eye
Dryness on loss	%	≤2.0	Oven dryness
PH(3% water solution)		3.0-4.5	PH meter
Melting point	℃	111.0-116.0	Melting point meter
Assay	%	≥98.0	HPLC
Total bacteria	Cfu/g	< 100	Dilute plate
Heavy metal	ppm	< 20	Absorb spectrum

Annotate: the data in the sheet is reference, practice data should be according to COA sheet.

3.2 Solubility

3-O-ethyl ascorbic acid is very soluble in water (≥10%), soluble in ethanol.



4. Stability

3-O-ethyl ascorbic acid is white, odorless powder, composed by ethyl and ascorbic acid. 3-O-ethyl ascorbic acid is etherified by ethyl at C3 position. This structure can avoid the oxidation of 3-O-ethyl ascorbic acid. According to 3-O-ethyl ascorbic acid crystal structure analysis, melting point, NMR, IR spectrum, MS and element analysis, prove: 3-O-ethyl ascorbic acid is C3 position substituted by ethyl, and a high pure ingredient.

In order to increase the stability of ascorbic acid, usually it is substituted by palmitate, phosphate or sulphate, but they all have a lot of problems. So we developed 3-O-ethyl ascorbic acid.

4.1 Stability character

3-O-ethyl ascorbic acid is stable, without discolored, affected by damp and agglomeration phenomenon.

We add 3-O-ethyl ascorbic acid into water, without any protective material, gain 2% 3-O-ethyl ascorbic acid solution, and then put up tests as follow:

Type	Test content	Test condition	Result
Heat	2% 3-O-ethyl ascorbic acid Solution	45°C, 90 days	Stable
Cold	2% 3-O-ethyl ascorbic acid Solution	-15°C, 90 days	
Light	2% 3-O-ethyl ascorbic acid Solution	Natural light, 90 days	
Oxygen	2% 3-O-ethyl ascorbic acid Solution	Room Temperature, 90 days	
Acid	2% 3-O-ethyl ascorbic acid Solution + 0.5%LA	Natural light, 90 days	
Alkali	2% 3-O-ethyl ascorbic acid Solution + 0.5% TEA	Natural light, 90 days	
Salt	2% 3-O-ethyl ascorbic acid ion Solution	Natural light, 90 days	



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5. Usage

5.1 Use dose:

Common suggested use dose 0.1-3.0%.

5.2 Use method:

Emulsify system: Cold add after dissolved in water (suggested). Add 3-O-ethyl ascorbic acid into suitable water, when below 60°C, add this solution into emulsify system.

Single system: Directly add 3-O-ethyl ascorbic acid into water, beat up evenly.

5.3 Usage:

- ◆ Inhibit the activity of Tyrosinase, prevent the synthesis of melanin.
- ◆ Improve the synthesis of collagen, accelerate the complexion of skin.
- ◆ Strong antioxidation, eliminate the free radical.
- ◆ Resist inflammation, inhibit the growth of bacteria.

5.4 Use products

- ◆ Whitening products: cream, lotion, gel, essence, mask, etc.
- ◆ Anti-wrinkle products: improve the synthesis of collagen
- ◆ Antioxidation products: eliminate free radical
- ◆ Anti-inflammation product: inhibit edema.

6. Package

0.5kg/plastic bottle, 20.0kg/cardboard barrel

7. Storage

7.1 Store method:

No especial condition, room temperature, dry, avoid light.

7.2 Store term

Store term is 2 years.



8. Reference

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9. Formulation Example

Anti-speckle cream

PHASE	Series No.	INCI Name	Level (%)
A	1	Cetearyl glucoside/cetearyl alcohol	2.00
	2	Glyceryl monostearate/ PEG-100 stearate	2.00
	3	Cetearyl alcohol	2.50
	4	Isopropyl palmitate	2.00
	5	Dimethicone	2.00
	6	Azone	2.00
	7	Tocopheryl acetate	0.30
	8	Butylhydroxy toluene	0.10
	9	Me-paraben	0.10
	10	Glabridin/Propylene glycol	8.00
B	11	Deionized water	To 100.00
	12	Propylene glycol	3.00
	13	Xanthan gum	0.20
	14	Glycerol	5.00
	15	Trimethyl glycine	2.00
	16	Allantoin	0.10
C	17	PG/Diaz urea/Me-paraben/ IPBC	q.s.
	18	Fragrance	q.s.
D	19	Ethyl Ascorbyl Ether	3.00
	20	Deionized water	5.00
	21	Triethyl amine	q.s.

Procedure

1. Heat phase A to 85°C
2. Heat phase B to 85°C, transfer into homogenization pot and homogenize for 3 minutes, then transfer oil phase to emulsifying pot and homogenize for 4 minutes.
3. Cool by cool water, stir till to 50°C, add phase C; stir to 40°C and then add Phase D, stir to completely dissolved. Fill into the bottle.



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Anti-wrinkle cream

PHASE	Series No.	INCI Name	Level (%)
A	1	Cetearyl glucoside/cetearyl alcohol	2.00
	2	Glyceryl monostearate	2.00
	3	Cetearyl alcohol	4.00
	4	Dimethicone	2.00
	5	Dicaprylyl carbonate	2.00
	6	Isopropyl palmitate	2.00
	7	Polysylane	2.00
	8	Tocopheryl acetate	0.50
	9	ButylHydroxy toluene	0.05
B	10	Me-Paraben	0.10
	11	Deionized water	To 100.00
	12	Xanthan gum	0.10
	13	Propylene glycol	3.00
	14	Glycerol	5.00
	15	Potassium monoalkyl phosphate	0.50
	16	Trimethyl glycine	3.00
	17	Allantion	0.10
	18	Disodium EDTA	0.05
C	19	Sodium hyaluronate	15.00
	20	Deionized water	4.00
D	21	Ethyl ascrobyl ether	2.00
	22	PG/Diaz urea/Me-paraben/IPBC	0.40
E	23	Fragrance	0.05

Procedure

1. Heat phase A to 85°C.
2. Heat phase B to 85°C.
3. Slowly add phase B to phase A, stir for 5 minutes.
4. Cool to 50°C, add phase C, D and E, mix well.



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Anti-sensitive speckle removal milk

PHASE	Series No.	INCI Name	Level (%)
A	1	Ceteareth-2	2.00
	2	Ceteareth-21	1.00
	3	Glyceryl monostearate	2.50
	4	Cetearyl alcohol	3.00
	5	Dicaprylyl carbonate	4.00
	6	Paraffin oil	4.00
	7	Tocopheryl acetate	0.50
	8	Azone	2.00
	9	Bisabolol	0.50
	10	Butylhydroxy toluene	0.10
	11	Me-paraben	0.10
B	12	Glabridin/propylene glycol	8.00
	13	Deionized water	To 100.00
	14	Glycerol	3.00
	15	Propylene glycol	2.00
	16	EDTA-Na ₂	0.10
	17	Xanthan gum	0.30
	18	Magnesium aluminium silicate	0.50
	19	Allantoin	0.20
	20	Ethoxydiglycol	3.00
C	23	Cyclomethicone	2.00
	21	Ethyl ascorbyl ether	2.00
D	22	Deionized water	4.00
E	24	Preservatives	Q.S.
F	25	Fragrance	Q.S.

Procedure

1. Heat phase A to 85±1°C.
2. Heat phase B to 85±1°C. Add phase A to phase B, mix well, homogenize for 4 minutes.
3. Separately add materials in phase C, cool by cold water. Add phase D at 50°C, mix well, and cool.
4. Add raw materials in phase F previously dissolved at 40°C, mix well.



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High Effective Anti-speckle essence

PHASE	Series No.	INCI Name	Level (%)
A	1	Deionized water	To 100.00
	2	Trimethyl glycine	3.00
	3	glycerol	5.00
	4	β -Glucan	3.00
	5	Ethyl ascrobyl ether	3.00
	6	Azone/PEG-40 hydrogenated castor oil	0.50
B	7	Glabridin/propylene glycol/PEG-40 hydrogenated castor oil	8.00
C	8	Fragrance	Q.S.
	9	preservative	Q.S.

Procedure

1. Add phase A, stir to dissolve;
2. Add phase B, stir to dissolve;
3. Add phase C, stir to dissolve.