REVIEW

Maca Cosmetics: A Review on Constituents, Therapeutics and Advantages

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Abstract: Herbal cosmetics are the focus of attention nowadays, they have various therapeutics, including, anti-oxidant, anti-radiation, anti-aging, anti-inflammatory. Maca contains polysaccharides, phenolics, alkaloids, minerals and amino acids, which is said to suitable component for cosmetics due to the single action or synergy action. The review summarized the existed and potential therapeutic effects of maca ingredients in cosmetics. And compared to the marketed cosmetics, maca cosmetics have the merits of mild, low-toxicity and the clear relationship efficacy.

Key words: maca, cosmetics, constituents, therapeutics

1 INTRODUCTION

Herbal cosmetics are the products that can clean body, beautify the appearance, change the appearance and increase the attraction. Globally, they have broad markets, the herbal cosmetics market share has reached more than 60%, and shows the growth status every year¹. Analysis the reason that caused the great properties in the international market, it is partly because of the great attention on the skin, the various functions of cosmetics and the raw material cosmetics. By summarizing the existed cosmetic products in market, we found that cosmetics had various therapeutics, including, anti-oxidant, anti-radiation, skin-lighting, anti-aging. In addition, herbal cosmetics had the characteristics of mild and low toxicity by comparing existing cosmetics. However, due to the complex compositions, the corresponding structure-function relationships have not been clear established.

Maca (Lepidium meyenii Walp.), is a cruciferous plant, mainly growing in the Peruvian Central Andes². As a medicine food homology plant, it has plenty of nutrition value and pharmacological effects. Previous studies indicated that maca could greatly enhance the fertility of sperm³ and improve memory. Moreover, it also has the cosmetic therapeutics of anti-oxidant⁴, anti-inflammation⁵ and anti-radiation⁶ (Fig. 1), which is relevant with the bioactive ingredients, such as, polysaccharides, amino acids, phenolics, alkaloids and minerals⁷. Furthermore, polysaccharides have the properties of anti-oxidant. Amino acids can nourish and moisturize the skin and whitening. Phenolics contain catechins, epigallocatechin gallate and epicatechin, they can play a role in the efficacies of anti-radiation, anti-oxidant, anti-inflammatory, anti-aging and skin-lighting by acting alone or cooperatively. Alkaloids can play a role in the effects of anti-inflammatory, anti-oxidant and anti-fungal. Besides the organics, minerals that maca contains also have the ability of anti-inflammatory. Therefore, in order to provide reference for the development of maca cosmetics, we summarized the chemical compositions, effect mechanisms, therapeutics and advantages of maca for its potential role in cosmetics (Fig. 1).

2 CHEMICAL COMPOSITIONS

The abundant therapeutics was decided by the various maca chemical ingredients, which were confirmed and the contents were calculated by the advanced methods. Previous papers indicated that maca is composed of several components, including, sugars (45.28%), proteins (22.38%), amino acids (6.95%), phenolics (2.8%),...
minerals (2.246%) and alkaloids (5.0%). Besides, the inorganic minerals were constituted of Na (0.700 ± 0.115%), Cu (0.044 ± 0.001%), B (0.051 ± 0.010%), Ni (0.024 ± 0.010%), and Zn (0.150 ± 0.022%).

In addition, the activity of maca is metabolized by benzyl glucosinolate and the secondary metabolites, isothiocyanates. Moreover, maca is characterized by the unique secondary compositions, the ingredients are macamides (0.0016~0.0123%) and macaenes. And the group constituted phenolics, including, flavonoids, catechins, epigallocatechin gallate, and epicatechin. The abundant compositions determine the therapeutics of maca products.

3 THERAPEUTIC PROPERTIES OF MACA IN COSMETICS

3.1 Anti-oxidants

Anti-oxidation mainly keeps the threshold value of free radicals in the equilibrium state by scavenging free radicals, which is the foundation of several pharmacological effects, including anti-inflammatory, anti-radiation, anti-aging. The role of anti-oxidant plays mainly through the decreasing of reactive oxygen species (ROS), the deoxyribonucleic acid (DNA) oxidation damage, the content of H2O2, and the lipid per-oxidation, which can be indicated by the results in vivo and in vitro experiments. The relevant pathway may be divided into the enzyme system and the non-enzyme system. Enzyme system mainly includes super oxide dismutase (SOD), malondialdehyde (MDA), catalase (CAT) and glutathione (GSH), which is the indicators in vivo and it can show anti-oxidant ability. Non-enzyme system is mainly including the anti-oxidant factors, including, phenolics, polysaccharides, alkaloids and minerals, which is used to be detected by the changes of the radicals, metals and carbonyls. Trolox equivalent antioxidant capacity (TEAC) assay, ferric ion reducing antioxidant power (FRAP) assay, and 2,2-diphenyl-1-picrylhydrazyl radical (DPPH) scavenging are commonly used to evaluate the ability of anti-oxidant in vitro. The relevant assay and mechanism are listed in Fig. 2.

3.1.1 Maca extract

Previous researches about maca indicated that they could play a role in anti-oxidant by reducing in Lactate Dehydrogenase (LDH) activity and increasing in SOD activity. Otherwise, the study of anti-oxidant focus on lipid peroxidation, indicated that maca significantly decreased the levels of very low density lipoproteins (VLDL), low density lipoproteins (LDL), total cholesterol and the level of triacylglycerols (TAG) in the plasma. The activities of enzyme systems, like SOD, GSH, glutathione peroxidase (GXP) were increased.

SOD is an important enzyme index that can scavenge the...
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radicals and decrease the ratio of ROS. The function plays mainly through the reaction that converts superoxide radical to $H_2O_2$, and react with CAT and SOD. In all, the increasing of SOD is beneficial to the anti-oxidation. In addition, GSH is composed of three amino acid composition of small molecular peptide. It can remove toxins the effects of material. As an important antioxidant and free radical scavenger in vivo, GSH can transform the harmful to the body of toxins into harmless substance and drain out of the body.

3.1.2 Polysaccharides

Polysaccharide is constituted by a complicated structure, which is composed of more than ten monosaccharides polymerization of polymer carbohydrates, the composition of polysaccharides is varied. Besides the research of complicated structure, the bioactivities of polysaccharide were interested in pursuing the potential therapeutics of maca polysaccharides.

The anti-oxidant activity of polysaccharides was evaluated by in vivo and in vitro experiments. As mentioned in the research of Zha, S. et al, maca polysaccharides were deproteinized and isolated four parts by ethanol precipitation at concentration of 60%, 70%, 80%, 90% respectively (named LMP-60, LMP-70, LMP-80, LMP-90). All parts and the maca aqueous extract (MAE) were tested by the antioxidant experiment in vitro including the experiment of TBARS, superoxide radicals and DPPH, indicated that maca polysaccharides with different treatment had the different anti-oxidant ability.

Hydroxyl radical is the important index of the oxidative injury. The eliminate of hydroxyl radicals mainly through product malondialdehyde (MDA), MDA is a product of lipid peroxidation, which can cause the macromolecular cross linking polymerization and influence the activation of mitochondrial respiratory chain complexes and key enzyme. As an important indicator for evaluate the degree of lipid peroxidation and the ability of scavenging hydroxyl radical. The increase of content of MDA can aggravate the damage of lipid peroxidation and lead to the cell toxicity. Superoxide radical assay is the experiment that can evaluate the $H_2O_2$ radicals by the decreasing of the fluorescence value, the more decreasing of the fluorescence value existed, and the better anti-oxidation ability existed. As the first generation substance among the oxidation reaction, superoxide can play the role by free radicals and the reactive oxidative it produced, such as hydroxyl radicals and singlet oxygen. It is the related reason of directly initiate lipid peroxidation and the hydroxyl radical produced.

Hydroxyl radical assay and superoxide radical assay evaluated the ability of scavenging radicals with different evaluation system which are related with the lipid peroxidation. The results indicated that maca polysaccharides had a great ability in scavenging radicals through decreasing lipid peroxidation. And superoxide could reduce the level of radical by decreasing the content of $H_2O_2$ and ROS, which may the reason that lead to the better ability of scavenging radicals than hydroxyl.

In vitro experiment, DPPH is the commonly used way that can detect the single electron radicals by declining the absorbance, the mechanism mainly through the decreasing of the level of ROS.

3.1.3 Phenolics

Phenol compounds are the structure of phenolic hydroxyl group as the basic parent nucleus. They are often associated with antioxidant activity, the ability of anti-oxidant often owning to the replace of hydroxyl and the ability of gobble up the free radicals.

A study revealed that phenolics had a great inhibition ability of scavenging radicals by the experiment of peroxynitrite, DPPH, TRAP and TBARS. In previous experiments, the mechanism of decomposition of peroxynitrite may attribute to the protection of DNA oxidation damage induced. The phenolics that maca contained have the ability to quench peroxynitrite. As a key step in lipid reaction, TRAP results indicated that phenolics could promote the decomposed of peroxyl radicals and the role of cytotoxicity. According to the results of IC$_{50}$ of scavenging DPPH and peroxyl radicals, indicated that maca had a better anti-oxidant ability of peroxyl than DPPH and maca significantly increased the production of ATP and decreased the ratio of ROS when treated with $H_2O_2$. In the deoxyribose experiment, Anti-oxidant was ascribed to the mitochondrial metabolism, which had a great ability to against the disorder and the responsibility for cellular damage. The phenolics of maca consisted of catechin, epicatechin, epicatechin gallate, epigallocatechin, epigallocatechin gallate and so on. The mechanism of anti-oxidant may due to the efficacy respectively or the synergistic effect of various monomers. For example, catechins enhance the defense of enzyme and decrease the content of $H_2O_2$. And the ability of neutralizing the active oxygen species is strongly associated with the conjugated double bonds and the number of hydroxyl groups in the aromatic ring. Epigallocatechin gallate (EGCG) can play the role in anti-oxidant by the increasing of enzyme of SOD, GSH-Px and CaMKK$\beta$ and liver kinase B1 (LKB1), the content of NO and multiple signal transduction pathways in vivo. Epicatechin (EC) increases the activation of the pathway in primary cortical, and NF-E2-related factor-2 (Nrf2), glutathione levels (Table 1 and Fig. 3).

3.1.4 Macamides

Macamides, a class of benzylated or 3-methoxybenzylated alkamides, has been identified as major characteristic compounds of contributing to the efficacy of maca, is composed of a variety of monomers hybrid material, such as, N-benzyllinoleamide, N-benzylpalmitamide and N-benzyloleamide. The research compared the anti-oxidant ability between N-benzyllinoleamide, N-benzylpalmitamide
and N-benzylololeamide. It demonstrated that N-benzylololeamide and N-benzyllinoleamide could improve the activities of antioxidant enzyme and reduce the per-oxidation of lipid. And the experiment compared the content of enzyme in liver and skeletal muscle, the direct results showed that it significantly decreased the content of MDA and the level did not have the distinction among the liver and skeletal muscle. Comparison that made between the liver and skeletal tissue of antioxidant enzyme and reduce the per-oxidation of lipid. And the experiment compared the content of enzyme in liver and skeletal muscle, the direct results showed that it significantly decreased the content of MDA and the level did not have the distinction among the liver and skeletal muscle. Comparison that made between the liver and skeletal muscle indicated that the activation of catalase activity was higher in liver than muscle with the concentration of lipid-soluble maca extract was 100 mg/kg. SOD activity did not have distinction significantly.

As the important anti-oxidant of the body, MDA, SOD and GSH-PX can balance the body metabolism and increase the level of immunity. With the environmental impact or cellular aging, the content of related enzyme will decrease. In order to promote the content, the supply of the exogenous antioxidants is important. Moreover, N-benzylololeamide has a more significant influence on the anti-oxidant status than others.

### 3.2 Anti-inflammatory

Inflammatory is a common skin problems, there are many reasons that may lead to the inflammation reaction. Radiation is a direct influence element that can induce erythema, edema and hyperplastic epithelial responses, which are considered as the markers of inflammatory. Besides the above reason, the generation of inflammation is associated with COX-2, phospholipase A2, and lipoxygenase.

#### 3.2.1 Flavonoids

As the research demonstrated that maca had multiple efficacies, including anti-inflammatory, anti-oxidant. The research indicated that the effect of anti-inflammation of maca mainly attributed to the flavonoids, Bai, N. et al. isolated flavonolignans from the maca extracts, including, tricin 4′-O-[theeo-β-guaiacyl-(7′-O-methyl)-glyceryl] ether (1) and tricin 4′-O-(erythro-β-guaiacyl-glyceryl) ether (2), and tricin (3), and the anti-inflammation ability was tested by the cell assay that played in the effects on nitrite production of LPS-activated RAW 264.7 macrophages. The results indicated that the order of inhibitory effect on nitrite production was (1) > (3) > (2), and compound (1) had a better anti-inflammatory activity and could inhibit the NO production significantly.

In addition, we divided the mechanism into two aspects by analyzing the related mechanism. On the one hand, it could inhibit inflammation-associated enzymes, decreased the activation of cyclooxygenases (COX) and lipoxygenases and regulated the expression of proteins which associated with inflammation. On the other hand, it could affect the production of proinflammatory cytokines and the expression levels of all or some parts of proinflammatory genes, including COX-1, COX-2, IL-1β, TNF-α, ICAM-1 and fibronectin.

#### 3.2.2 Alkaloids

Alkaloid is a nitrogenous organic compound without the
essential nitrogen compounds of body contains. The research of total alkaloids demonstrated that it had anti-inflammatory effects\(^{27}\). We summarized the possible mechanism of the corresponding therapeutics of alkaloids. Research indicated that alkaloids could manifest the anti-inflammatory activity by significant increasing the levels of TG, TC, LDL-C and decreasing the level of HDL-C. The possible mechanism may attributed to the regulation of the NF-κB pathway and downregulation of the proinflammatory genes, including, COX-2, IL-6 and TNF-α\(^{58}\). NF-κB, COX-2, IL-6 and TNF-α were the signaling pathway of inflammatory reaction. Furthermore, NF-κB is the key factor of inflammatory and it is the transcription factors that can regulate many inflammatory response genes\(^{59}\) and can lead to the production of iNOS, COX-2, TNF-α, IL-6\(^{60,61}\). As the product of iNOS catalyze produces, NO can lead to the DNA damage, gene mutation and inflammatory reaction. So the more iNOS existed, the more serious inflammatory pathway that converts arachidonic acid (AA) into prostaglandins. TNF-α is produced by the macrophages that associated with inflammation, the lower content is beneficial to the anti-inflammation reaction. As the immune factor, IL-6 can activate T cells and the lymphatics produced by fibroblasts, in turn, boosting the immune response.

### 3.2.3 Minerals

Mineral elements are important kind substances both in food and medicine, the content and the type of minerals determines a wealth of pharmacological activities\(^{62}\). The research indicated that maca had abundant minerals, such as B, Co, Cr, Li, Ni, Zn, Na. Compared to the content of minerals in China and Peru, the results indicated that maca in China had a higher content of minerals than Peru\(^{11}\). Different mineral has different therapeutic, the detailed research is showed in the latter.

Copper was a high content substance in minerals, which had abundant biological actions and played a role as a coenzyme factors effect in many pathways\(^{63}\). Copper can modulate prostaglandin synthesis\(^{54-56}\) and the expression of interleukin IL-2\(^{27}\) and neutralize reactive oxygen radicals\(^{65}\). Otherwise, copper is the composition of CuZnSOD and the active center, which could transfer the electron, bond the foreign molecule and conduct the catalytic reaction. The product CuZnSOD was an enzyme that could eliminate $\text{O}^2-$, and the added of Cu\(^{2+}\) and Zn\(^{2+}\), which made it had the advantage of thermodynamic stability and dynamic inertia\(^{66}\). Copper can play the anti-inflammatory activity as a chelating agent\(^{63}\).

#### 3.3 Anti-radiation

Ultraviolet radiation (UVR) can lead to the modern skin disease, the research demonstrated that maca can decrease the oxidative damage induced by UV radiation both in vitro and in vivo. Generally, UVR can divide into three kinds by the wavelength, such as UVA, UVB, UVC. UVA and UVB can produce several damage in skin from the natural source, UVC can damage the human skin from the artificial sources\(^{67,70}\).

The research of maca indicated that it had a great ability of preventing UV-induced skin damage. And we can know that it could decrease the damage of UVA, UVB, and UVC with a dose–response effect. Compared to the maca extract without boiling, the extract with boiling had a better effect against UV irradiation\(^{58}\). The ability of anti-radiation of maca may attribute to the abundant substances, such as, flavonoids, anthocyanins, polyphenolics, benzyl glucosinolates. The relevant mechanism was showed in Table 2\(^{72,73}\).

#### 3.4 Anti-aging

Skin aging is a necessary process because of the continuously increase of the life, which is regarded as the focus with the development of cosmetics. The pathomechanisms of skin aging can divide into two kinds, intrinsic and extrinsic. The research demonstrated that cellular ageing and telomeres shorten, mitochondrial DNA mutation, oxidative stress, genetic mutation and several hormone levels decreased may lead to the intrinsically aged skin\(^{80}\). In addition, maca could increase the proliferation capacities of aged fibroblasts, balance the intrinsic cutaneous aging, decrease the parameters of wrinkles and improve radiance and luminosity.

Maca’s function of anti-oxidant is a good way to decrease intrinsic skin aging\(^{81}\). Extrinsic skin aging arises from UV-light exposure, tobacco smoke, infrared radiation and so on, in which UV-exposure is the mainly reason that leads to
the extrinsic skin aging. The biological effect of skin aging based on UVA which is relevant the high penetration depth. The influence of UVB mainly includes the absorption of UVB in epidermis and the cause of the DNA damage. It indicates that the anti-radiation activity is the fundamental of anti-aging activity. In all, inflammatory response and oxidative stress mechanism are skin aging markers. The substance of maca contains is related with anti-oxidant, anti-inflammatory and anti-radiation, in which phenolics is the major role of the therapeutics. Phenolics consist of several substances, which are capable of modulating signaling cascades of anti-aging and the effects of anti-aging that derives from the accumulation over a lifetime of oxidative damage to cells by reducing the oxygen species and anti-inflammatory that can prevent UV-induced skin damage. In addition, phenolics not only can recover the expression level in normal cells but also it can increase the cell numbers. The anti-aging ability is consistent with the anti-oxidant therapeutics. Besides the anti-oxidant ability, phenolics also can modulate the expression of pro-inflammatory cytokine gene CCL5 (chemokine (CC motif) lig and 5). This gene encodes a chemotactic cytokine involved in immunoregulatory and inflammatory processes. And compared to the aged cells, the expression of CCL5 gene was decreased, the results indicated that aged cells were related with the inflammatory disorders.

### 3.5 Skin-lighting

There are several reasons that lead to the melanin produces, including UV and oxidative damage. UV-induced skin damage can be prevented by melanin, but too much UV radiation can lead to the melanin products. The specific mechanism may be attribute to the UV photons on DNA can result in up-regulation of the tyrosinase gene and cause the generation of epidermal hyper-pigmentation. And the production of ROS that caused by UV radiation was also the reason that lead to the melanin biosynthesis and DNA damage. Anti-oxidant is the method that can suppress melanogenesis in the epidermal layer. The research indicated that maca rich in proteins and secondary metabolites, including various kinds of amino acids, such as, lysine, glutamic acid, serine, leucine, tyrosine, alanine, histidine. Various researches indicated that the purpose of the use of the proteins for cosmetics is available. The ability of proteins in cosmetics attributed to bind water with the horny layer skin. Higher molecular weight proteins were unsuitable for use in cosmetics. There were two kinds of existence forms of maca proteins secondary metabolites, including free amino acids and hydrolyzed amino acids. The contents of amino acids were abundant, the secondary metabolites made it possible to observe the cosmetic performances. In addition, various different therapeutic was decided on the structure of the kinds of amino acids. We summarized the possible properties of maca amino acids in cosmetics. And we found that the properties are strongly dependent on the differences between the quantitative and the qualitative (Table 3 and Fig. 5).

![Fig. 4](image) The relevant therapeutics of phenolics in cosmetics and the relevant mechanism are listed in the figure.
As herbal cosmetics, there are multidisciplinary applications and beneficial properties to maintain and increase beauty, such as anti-aging, anti-oxidant and anti-radiation. Compared to synthetic cosmetics, herbal cosmetics have the benefits of low toxicity, mild and no hormone stimulation. Herbal cosmetics are constituted of various herb ingredients. Existing market products mainly include functional cosmetics, therapeutic cosmetics, and so on.

Botanical extract cosmetics is the main exist in herbal cosmetics market, it has various properties due to its multi-compositions. Pomegranate fruit extract has the ability of anti-oxidant because it could reduce erythema and reduce the sunlight of immunosuppression and formation of DNA adduction. Tetrahydrocurcuminoids could modulate the collagen that caused by aging and the immune system. The details of herbal cosmetics were indicated that the properties were presented by the extract or the monomer, the property of cosmetics was single and unclear.

Compared to the existing cosmetics products, the mechanisms of maca cosmetics were defined, and the possible property was estimated. The summary of constituents of maca in cosmetics indicated that the plant had various therapeutics, which was relevant with cosmetics, and some potential effects of maca ingredients in cosmetics. The article was a summary of the therapeutics of maca ingredients and the relevant effects of maca substances in cosmetics. And the article made a comparison with the marketed products, it showed that the herbal cosmetics has the advantage of mild and low-toxicity. In all, we summarized the existed and potential mechanism of maca in

<table>
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<tr>
<th>CONTENT</th>
<th>THERAPEUTICS</th>
<th>MECHANISM</th>
<th>REFERENCES</th>
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<tr>
<td>Glutamic acid</td>
<td>Moisturizing</td>
<td>Convertto moisturizing factor, five sorbic acid (PCA)</td>
<td>(^{(104)}) Fang, Z.J.</td>
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<tr>
<td></td>
<td>Whitening</td>
<td></td>
<td>(^{(105)}) Masahiro, T. et al.</td>
</tr>
<tr>
<td>Lysine</td>
<td>Moisturize</td>
<td>Helical structure, retaining water</td>
<td>(^{(105)}) Masahiro, T. et al.</td>
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<tr>
<td>Serine</td>
<td>Anti-wrinkle</td>
<td>The vitality and moisture of epidermal cells ↑</td>
<td>(^{(105)}) Masahiro, T. et al.</td>
</tr>
<tr>
<td>Proline</td>
<td>Sun block</td>
<td>Ring structure, retaining water</td>
<td>(^{(105)}) Masahiro, T. et al.</td>
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<tr>
<td>Leucine</td>
<td>Nutrition</td>
<td>Promote skin regeneration and healing</td>
<td>(^{(104)}) Fang, Z.J.</td>
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<td>Tyrosine</td>
<td>Sun block</td>
<td>The precursor substance of melanin</td>
<td>(^{(104)}) Fang, Z.J.</td>
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<tr>
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Fig. 5 The representative amino acids molecular structures.

5 CONCLUSION

With the increasing attention of facial beauty and health, cosmetics are essential for a better demand for health and beauty and the better quality life. The function of cosmetics is various, including anti-oxidant, anti-radiation, anti-aging. The preparation of cosmetics needs the clear mechanisms of the therapeutics.

As a medicine food homology plant, maca has abundant substances, the existing researches indicated that it had various therapeutics, which was relevant with cosmetics, and some potential effects of maca ingredients in cosmetics. The article was a summary of the therapeutics of maca ingredients and the relevant effects of maca substances in cosmetics. And the article made a comparison with the marketed products, it showed that the herbal cosmetics has the advantage of mild and low-toxicity. In all, we summarized the existed and potential mechanism of maca in

cosmetics and the comparison with the marketed cosmetics. However, the direct relationships between the effective contents and the pharmacological effects of maca cosmetics were seldom to establish, and the studies were seldom to explore. Zha, S. et al. found that maca polysaccharides at 2 mg/mL had great radical scavenging ability. The study of Ángel, R.H. et al. indicated that maca methanol extract could significantly inhibit oxidative stress in the cell assay at 5 and 10 μg. Throughout the summaries, we found that the inconsistent experiment methods would be bad for the content-function establishment and the direct effective contents were hardly to show. The further study of content-function researches need to be conducted and the maca cosmetics researches need to be explored. In addition, the herbal cosmetics usually work by the synergistic effect, the pharmacological activities of single substances were seldom to show. In order to better fit in the market demands, the studies of single substance need to be conducted.

Table 4  
Marketed products(www.lipochemicals.com)\(^\text{110}\).

<table>
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<th>PRODUCT NAME</th>
<th>THERAPEUTICS</th>
<th>ACTIVE INGREDIENTS</th>
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<td>Gorgonian Extract</td>
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<td>Bisabolol</td>
<td>1. Anti-aging</td>
<td>Bisabolol</td>
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<tr>
<td>Sodium Hyaluronate</td>
<td>1. improve elasticity</td>
<td>Hyaluronic Acid (HA)</td>
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<tr>
<td>Phytoesteryl Macadamiate</td>
<td>1. smoothing</td>
<td>Macadamia nut oil fatty acids and soy phytosterols</td>
</tr>
</tbody>
</table>

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Conflict of interest

The authors did not declare conflict of interest.
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