

Herbal Cosmetics and Novel Drug Delivery Systems

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ABSTRACT

Herbal cosmetics are defined as the products which prepared by or included plants and/or herbal components which are combination of many natural molecules or compounds. In this context, critical parameters that affect the final quality and stability of herbal cosmetics are the specifications of herbal inputs, structure of formulation and manufacturing process. In addition to produce according to the good manufacturing practices of cosmetics (ISO 22716) in case of being natural or organic cosmetic it needs to meet the related international standard for technical definitions and criteria of natural and organic cosmetic ingredients and products (ISO 16128). Novel drug delivery systems are used in herbal cosmetics and between them vesicular, particular and emulsion based delivery systems are most preferable delivery systems. The advantages of such systems for herbal cosmetics can be listed as; enhanced efficacy, improved stability and decrease allergic potential of some herbal substances. As a result, choosing an appropriate drug delivery system for a herbal cosmetic is able to provide increased efficacy, stability and enhanced safety of the final product. Besides these advantages above mentioned since herbal cosmetics have become more complicated the fulfillment of quality requirements either during production or after packaging and during shelf life would be critical that need to fulfill long-term stability and dermatological safety.

Key words: Herbal cosmetics, Naturel sources, Novel delivery systems, Standards, Stability.

INTRODUCTION

The cosmetics have been originated from plants in its historical development. Traditional use of plants for cosmetic purposes based on perfuming and skin care in the form of infusions, poultices and etc. In the last century, researchers have been focused on plants to investigate their efficacy and safety in cosmetics field. Generally herbal sources are rich with vitamins, antioxidants, oils (essential etc.) hydrocolloids, proteins, terpenoids and other bioactive compounds which have functions in the scope of cosmetics such as anti-aging, anti-oxidant, emollient effect etc. Herbs can be utilized for cosmetics in different forms as: i. a part of herb, ii. total extract of the herb, iii. extract of selective parts or iv. specific molecules purified from extracts. According to the composition of herbal raw materials herbal cosmetics which contain one or more herbal

ingredients present different activities or properties. In the scope of herbal cosmetics phytocosmetics are defined as the products which prepared only by plants and/or herbal components and mainly included; plants, plant extracts, volatile oils, distillates, aromatic waters, juices, aqueous extracts, tinctures, resins, gums and congenerous, herbal oils-lipids, waxes, mucilages, plant carbohydrates or purified plant components. Significant activities in case of phytocosmetics are generally; antioxidant activity, antityrosinase activity and antimicrobial activity. As the phytoformulation is a mixture of more than one active ingredient, care should be taken to the determination of the stability profile for phytocosmetics/herbal cosmetics.¹⁻³ Quantitative standards of all the herbal components need to determined according to a globally acceptable reference such as

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The Ayurvedic Pharmacopoeia of India, Chinese Pharmacopoeia and etc. Critical parameters that affect the final quality and stability of herbal cosmetics/phytocosmetics are the specifications of herbal inputs, structure of formulation and manufacturing process. In this context the critical analyses of quality control of herbal raw materials are performed in addition to in-process and the post-analyses of the herbal cosmetics. As a main requirement Cosmetic Good Manufacturing Practices (ISO 22716) need to be adopted to herbal cosmetic/phytocosmetic producing processes. Briefly critical issues can be indicated as follows; i. All components and manufacturing processes required to be standardized and documented. ii. A quality assurance system need to be established. In addition to produce according to the good manufacturing practices of cosmetics in case of being natural or organic cosmetic it needs to meet the related international standards the ISO 16128-1 and ISO 16128-2 which provides guidelines on definitions and criteria for natural and organic cosmetic ingredients and products.^{4,7} In this direction the controls and analyses that can be carried on herbal raw materials and ingredients can be listed as; i. organoleptic controls, botanical controls, product packaging, lot number, labeling (harvest date), ii. physical controls (resolution, fluorescence analysis, swelling index, foaming index etc.), iii. chemical controls (qualitative identification reactions, quantitative analyses, determination of impurities, bitterness value, the determination of heavy metals, pesticide residue analyses, mycotoxin control, determination of radioactive contamination, etc.), iv. biological controls (microbial contamination control), v. chromatographic and spectroscopic analyses (HPLC, GC, TLC, IR, UV-Spectrometer, etc.).^{4,9} Herbal cosmetic products which are formulated with novel drug delivery systems have presented advanced cosmetic specifications by means of anti-aging, antioxidant, anti-cellulite, anti-hair loss, anti-microbial, anti-blemish, nourishing and moisturizing effects. In cosmetics, the main concern is to reach the cutaneous cells to obtain better topical efficacy. The use of novel drug delivery systems in cosmetics provides capabilities of enhancing cosmetic ingredients to deeper skin tissues, increase the duration of action, increase the stability, eliminate incompatibility with other ingredients in the cosmetic formulations or the prevention of undesirable effects that may occur in the administration site. Encapsulation techniques are most widely used in cosmetics to achieve above mentioned purposes. Among the delivery systems following indicated three groups are generally used for cosmetics. The first group is vesicular systems; liposomes, silicone vesicles and matrices and the multi-walled delivery systems can be accepted the most

important group. The second group is the emulsions; microemulsions, liquid crystals, multiple emulsions, nanoemulsions and pickering emulsions can be accepted as the largest group. The third group is the debated particulate systems; microparticles, porous polymeric systems, nanoparticles and cyclodextrin complexes.¹⁰⁻¹⁴ Safety is an important issue especially for complicated cosmetics. Despite it is assumed herbal cosmetics have less adverse effects than the synthetic based ones, the safety evaluation is being decisive for the safety of all cosmetics. In broad perspective plants originated adverse effects and their evaluation is falling under phytopharmacovigilance which searches proper identification of plants, procurement of the raw material, process of extraction, the percentage of the active ingredients and marker compounds, etc. For the irritation potential of herbal cosmetics, *in vitro* cytotoxic potential of herbal sources could be performed in several human cell lines. Adverse effect is termed as an undesirable effect for cosmetics. With the use of cosmetics under normal or reasonably foreseeable conditions of the spontaneous gathering of undesirable effects observed reporting, evaluation and monitoring activities are expressed as a warning system which called as cosmetovigilance.¹⁵⁻¹⁶

HERBAL SOURCES

Cosmetic products can be formulated either for personal cleaning and care or for various advanced purposes such as reducing wrinkles, spots, cellulite and etc. Herbal cosmetics are generally developed for purposes such as moisturizing dry skin, anti-aging effect, reducing wrinkles, skin lightening, removal of dark spots, controlling oil secretion, anti-dandruff effect, skin protection, hair care and anti-oxidative antipollution effects. In some cases and requirements, only specific functional active ingredients can achieve mentioned purposes effectively. These specific functional active ingredients can be accepted as common cosmeceutical ingredients such as; hydroxy acids (alpha hydroxy acids /AHAs: citric acid, malic acid, glycolic acid, lactic acid, pyruvic acid, tartaric acid, lactobionic acid, and beta hydroxy acids/ BHAs: salicylic acid referred as fruit acids), antioxidants (alpha-lipoic acid/ALA, L-ascorbic acid/ vitamin C, niacinamide/vitamin B3, N-acetyl glucosamine/NAG, α -Tocopherol and ubiquinone/CoQ10), botanicals (grape seed extract and ferulic acid), depigmenting agents (hydroquinone, ascorbic acid/vitamin C, kojic acid and liquorice extract), retinoids (retinoic acid/tretinoin, retinol and retinaldehyde), hyaluronic acid and ceramides.^{10,17-19} In addition to their positive effects on the skin, herbal sources also can be used as an alternative

Table 1: Some of the plants used for cosmetic purposes and used product forms.^{2,20-22}

Species	Used parts	Active components	Benefits	Product forms
Cocos nucifera	Oil, Fruits, seeds	Fatty acids	Useful for itching and rashes, Moisturizing, Softening	Bath products, eye makeup, hair care products, shaving creams, suntan products, skin care products and lipsticks.
Helianthus annuus	Oil, Flowers, Leaves, Seeds,	Lecithin, tocopherols, carotenoids, waxes	Smoothing	Hair care products, skin care products, creams
Aloe vera	Leaves	Glucmannans, Anthraquinones, lignins	Moisturizing, Softening, Useful for healing, UV protection	Bath products, shaving creams, skin care products and lipsticks. Lotion, cream
Rhodiola rosea	Golden root	Flavonoids, Monoterpenes, Triterpenes, Phenolic acids	Antioxidant, Moisturizing	Skin care products
Daucus carota	Fruits, seeds, flowers, leaves, roots	Vitamin A	Anti-Aging, Revitalizing, Rejuvenating Smoothing	Skin care products
Ginkgo biloba	Leaves, roots	Terpenoids	Antioxidant, tonic	Hair care products, skin care products,
Lawsonia inermis	Leaves, flowers	Lawson (a dye molecule)	Hair coloring and nourishment	Hair care products,
Azadirachta indica	Leaves, Seeds, Barks	Nimbin, Nimbinin	Antioxidant Antiseptic,	Skin care products,
Camellia sinensis	Leaves, Flowers, Roots, Seeds, sprouts	Catechins	Skin Protectant, Antioxidant,	Oral care products, skin care products,
Curcuma longa	Leaves, Rhizomes, Roots	Curcuminoids	Skin protectant, Antioxidant, Antiinflammatory, Perfuming	Eye care, skin care products, creams
Emblica Officinalis	Fruits	Vitamin C, phosphorus, iron, calcium	Anti-aging, Skin Lightening, Skin protectant, Photoprotectant, Antioxidant	Skin care products, creams
Prunus dulcis	Oil	Omega-3, phenolic compounds	Nourishing, softening, cleansing, antioxidant	Bath products, hair care products, cleansing products
Rosa Damascena, Rosa centifolia	Flowers, Leaves, fruits	Beta-damascenone, beta-damascone, beta-ionone	Perfuming, tonic	Bath products, skin care products, hair care products, cleansing products
Eucalyptus	Leaves, Oil	α -Pinene, 1,8-Cineole	Anti-dandruff	Oral care, hair care products, skin care
Castanea Sativa	Barks, Flowers, Leaves, seeds	Rutin, hesperidin, quercetin, apigenin, morin, galangin, kaempferol, isoquercitin	Antioxidant Antiaging	Skin care products
Juglans regia L.	Seeds, Flowers, Leaves,	phenolic compounds	Antioxidant	Hair products
Olea Europaea	Barks, Flowers, Fruits, Leaves, seeds	Hydroxytyrosol, tyrosol	Antioxidant, Softening	Skin care products
Vitis vinifera	Seeds, Flowers, Fruits, Leaves	Proanthocyanidins	Antioxidant, Skin protecting Rejuvenating	Skin care products

for synthetic chemical compounds that used as excipient in cosmetic formulations such as emollients, surfactants and preservatives. Following examples can be given for plants which can be used instead of synthetic compounds: Instead of petrolatum and paraffinum liquidum, almond and sunflower oils and cocoa butter can be used. Aloe vera and Calendula can be used as emollient instead of cetyl/stearyl alcohol and stearalkonium chloride. As an alternative for Sodium Lauryl Sulphate, cocamide DEA and triethanolamine, Quillaja and Yucca saponins, Coconut and Palm Oil soap can be used as foaming agents. Hamamelis extract can be used for its astringent property as an alternative for ethyl alcohol. Generally used preservatives such as methylparaben, propylparaben, imidazolidinyl urea and phenoxyethanol have a variety of natural alternatives including Citrus seeds/peel extract, Eucalyptus, Tea tree oil, Green tea extract and ginger. A lot of plants used for coloring such as Beetroot powder (red), Carmine powder (purplish red), Paprika oleo-resin (orange red), Saffron (yellow-orange), carotenes (orange) and curcumin (yellow).^{1,2,20} Some of the plants used for cosmetic purposes and used product forms are presented in Table 1.

Activity of herbal cosmetics depends on not only the active chemical components of the plants used, but also many factors such as storage, packaging, microorganisms and pesticide residue; what time and which place the plants were collected and the environmental factors. To control these factors to provide the efficacy of the plants; standardization of herbal raw materials and final products are important.^{4,23} Herbal ingredients and cosmetics must be free from insects, pests, fungi, micro-organism, insecticide and pesticide. They must be free from heavy metals; if heavy metals can't be removed, they must be within the permitted limits. They must show no abnormality in odor, color, taste and other signs of decomposition. Proper cleaning, sterilization, storage and handling conditions and compatible packaging materials for natural raw herbs or herbal ingredients must be provided. To preserve the stability of natural materials, exposure to light, air, moisture, heat and microorganisms must be kept under control.⁴ By taking into considerations these factors; stability studies must be designed in such a way that they include the tests for the physical, chemical, biological and microbiological features that are tended to change during storage and have effect on quality, safety, and efficacy of finished products. Tests should be conducted according to validated methods.²⁴ Manufacturers must ensure the bioactivity of the natural components that herbal cosmetics contain, need to be retained through the shelf life. The quality control testing including organoleptic

characteristics, pH, viscosity and stability towards light must be carried out on the natural raw materials and the finished products.²⁰

NOVEL DELIVERY SYSTEMS

The use of pharmaceutical delivery systems in cosmetics provides capabilities of enhancing cosmetic ingredients to deeper skin tissues, increasing duration of action, increasing stability, preventing incompatibility with other ingredients in the formulations or preventing the undesirable effects that may occur either locally or systemically (the undesirable effects faced with cosmetic products can be local; irritation, allergy, phototoxicity, photoallergy, systemic; damage to respiratory system, blood and organ systems, embryotoxic, teratogenic, estrogenic effects, mutagenic/photomutagenic and carcinogenic/ photocarcinogenic effects).¹⁵ To obtain above mentioned advantages searched and preferred delivery systems can be listed as; vesicular systems such as liposomes, niosomes, nanosomes, phytosomes, herbosomes, marinosomes, oleosomes, aquasomes, ultrasomes, photozomes, ethosomes, transferosomes, sphingosomes, colloidosomes; multilayered carriers; silicon carriers and matrices; emulsified systems such as microemulsions, multiple emulsions, nanoemulsion; microgel, nanogel, liquid crystals; particular systems such as microparticles, nanoparticles, solid lipid nanoparticles, nano-structured lipid carriers, microcapsules, nanocapsules, microspheres, nanocrystals and cyclodextrins.^{11,14,25-28} These delivery systems can be given in various pharmaceutical forms such as emulsion, gel, emulgel, bigel, etc. to obtain finished cosmetic product. As they are used in new generation advanced cosmetics, novel drug delivery systems are also used for herbal cosmetics. Developments of such formulations have also caused increase in patenting of cosmetic ingredients and formulations especially in the last decades.²⁹ Among the novel delivery systems vesicular delivery systems (liposomes, nanosomes, phytosomes, herbosomes, marinosomes, oleosomes etc.), solid lipid nanoparticles, nanostructured lipid carriers and nanoemulsions are the most preferable systems.^{25,26} Advantages of such systems for herbal cosmetics can be listed as; improved stability, enhanced efficacy and decrease allergic potential of some herbal substances. Liposomes are using in personal care products due to their benefits, such as sustained release, reduced toxicity, increased stability, and increased bioavailability. They are especially used in many anti-aging products to encapsulate vitamins, antioxidants, and natural botanical extract.^{10,12,14} Niosomes had been developed as an alternative controlled drug delivery systems to liposomes in

order to overcome the problems associated with sterilization, large scale production and stability. The first niosome report came from a cosmetic company and then other cosmetic and drug industries started to use. Regarding nanoparticle efficiency there are many studies in cosmetic field to achieve the controlled release and targeting the cosmetic actives. Nylon nanoparticles are also used in make-up and skin care products to absorb oil and sunless tanning of the skin. Most of the nanocapsules are investigated for delivery of antioxidants and sunscreen agents. However, nanoparticle use in cosmetics is limited due to possible toxicity of the by-products.²⁷ Lipid nanoparticles such as solid lipid nanoparticles and nanostructured lipid carriers have gained attention for dermal application of cosmetic active substances to achieve targeting and sustained release of active substances to the different layers of the skin.^{11,13} Above indicated delivery systems have been widely used in advanced cosmetic products defined as cosmeceuticals, dermocosmetics, functional cosmetics, quasi drugs which can also be herbal cosmetics. From this point of view the use of pharmaceutical delivery systems that can be used in herbal cosmetics are briefly presented as follows.

Vesicular Delivery Systems

Liposomes are phospholipidic vesicular systems including natural phospholipid lecithin which is obtained from soybean or egg. Both lipophilic and hydrophilic cosmetic actives are able to load liposomes but they are not allowed to reach systemic absorption and thus minimize undesirable effects.¹⁰ Liposomes have been used in skin care cosmetics including cosmetotextiles. Transfersomes are vesicular systems that presented better performance than liposomes in terms of suitability for wide range molecular weight cosmetic actives, compatibility, efficacy, permeability, ultraflexibility and mechanical strength. Sphingosomes that are prepared with natural or synthetic sphingolipids have presented better stability than liposomes and offers targeting cosmetic actives to desired tissue, increase efficacy, stability and decrease toxicity of the cosmetic active substance.^{10,25,28} Phytosomes or Herbosomes have been prepared by polar botanical derivatives and generally plants including polar or water soluble molecules. They have offer advantages like; enhances the absorption of lipid insoluble polar phytoconstituents resulted as better efficacy, increased stability and decreased undesirable effects.^{10,28} Marinosomes are vesicular structures based on a natural marine lipid extract containing high ratio of polyunsaturated fatty acids which are metabolized by skin epidermal enzymes into anti-proliferative and anti-inflammatory metabo-

lites, thus become an advantage for skin care products. Ethosomes are composed of phospholipids, ethanol in high concentration and water. Due to ethanol is an efficient permeation enhancer ethosomes are able to deliver active ingredients to the deep layers of the skin. Ethosomes are accepted as safe for cosmetic use. Colloidosomes are hollow elastic shells composed of colloidal particles having high encapsulation efficacy, permeability, mechanical strength and compatibility which are able to use for cosmetics.^{10,25} Niosomes are non-ionic surfactant based vesicle carriers that can be used to encapsulate cosmetic actives and enhances their permeation to the skin. Niosomes which are stable systems can improve stability of cosmetic actives and they are also less irritating than other colloidal vesicle carriers. Silicone vesicles and matrices consist of silicone elastomers and elastomer blends that can be used to entrap various cosmetic active ingredients.³⁰ Silicone vesicles and matrices are able to use as cosmetic delivery systems in hair and skin care products. Physical associations of hair care actives with silicones have capability of improve conditioning, shine, reduce flyway and etc. The multi-walled delivery systems have provided long-term stability to cosmetic actives containing products for skin applications. They have nourishing and protecting property for the skin. They are effective on delivery of sunscreens and peptides.^{10,11}

Emulsion Delivery Systems

Microemulsions are stable liquid dispersions of three to four components; water, oil, surfactant/s and co-surfactant/s. They used to delivery of cosmetic actives and decided due to good cutaneous tolerance and balanced lipophilic and hydrophilic property. Liquid crystals are the forms between conventional liquid and solid crystals.³¹ Liquid crystals allow lipophilic materials (vitamins etc.) incorporated into its matrix and protected them from thermal and photo degradation. In case of cosmetic actives delivery, emulsions containing liquid crystals have presented long lasting effect also provided stability of actives. Multiple emulsions generally can be w/o/w or o/w/o types in which globules of the dispersed phase encapsulate smaller droplets. Although w/o/w systems have been decided for cosmetics, their low stability have been restricted their use.³² Nanoemulsions are o/w dispersions that having droplet diameter smaller than 100 nm. Compared with microemulsions they have low stability but high penetration and hydration properties that is desired for cosmetics. Nanoemulsions allow transparent appearance and different rheological behaviors which have presented advantages for skin and hair care products.^{11,31} Pickering emulsions

are o/w type emulsifier-free emulsions that are stabilized by solid particles (hydrophobically modified titanium dioxide, colloidal silica etc.) which adsorb onto the interface between the two phases. They are characterized by good skin tolerability and exhibit higher effectiveness in sunscreen products.³³ Microgels are nanosized crosslinked particles that can form stable suspensions in water. They have presented different viscosity due to particle size of microgels and large surface area that allow better efficacy for cosmetic active ingredients. Nanogels are water soluble forms which consist of crosslinked, sub-micrometer sized particles made of hydrophilic polymers. They prefer in device mediated cosmetic applications such as derma-roller which enhances skin penetration of cosmetics.³⁴

Particulate Delivery Systems

Microparticles are solid polymeric particles that are used in cosmetics to avoid incompatibility of substance, reduce odour of cosmetic actives and to protect active substances against oxidation or action by atmospheric moisture. Microcapsules are rather decided for encapsulation of cosmetic ingredient or formula for cosmetotextile applications. Microsponges are highly cross-linked, porous, polymeric microspheres that can be divided into microporous-microbeads and microporous-macrobeads. They have presented advantages of sustained release and reduced irritation of cosmetic actives with an enhanced stability and efficacy.³⁵ Nanoparticulates can be divided as nanospheres and nanocapsules that are both used in cosmetics. Solid lipid nanoparticles have presented advantages like enhanced skin hydration, protection against degradation, active penetration enhancement and sustained release of cosmetic actives. Nanostructured lipid carriers are nanoparticles in which the fluid lipid phase is embedded into the solid lipid matrix. Nanoparticulate systems show better stability than vesicular and emulsion systems.^{11,26,27} Cyclodextrins are cyclic oligosaccharides which are able to form inclusion complexes with cosmetic actives. Cyclodextrins are able to use for cosmetics and cosmetotextiles.^{36,37}

CONCLUSION

Herbal cosmetics that are designed with novel drug delivery systems have presented some advantages such as providing high efficacy, enhanced stability, reduce undesirable effects and better aesthetic appearance of products. Besides these advantages novel delivery systems including herbal cosmetics have become more complicated in which quality requirements both during production, packaging and shelf life would become

critical and thus need to be proved by long-term stability and dermatological safety tests.

CONFLICT OF INTEREST

The author declare no conflict of interest.

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