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NANOEMULSION FOR COSMETIC APPLICATION

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ABSTRACT
The application of Nanoemulsion is one of the growing technologies used in food, cosmetic and pharmaceutical industries as a novel delivery system for drugs and lipophilic materials such as essential oils, flavours, colours and fatty acids. These technological application of nanoemulsions have increasing used in the cosmetic applications due to their characteristic properties of small droplet size (in the range 20-200 nm) with high interfacial area, transparent or translucent appearance, high solubilization capacity, low viscosity, and high kinetic stability due to sedimentation, flocculation, and in some cases, the coalescence. Nanoemulsions are more suitable delivery system for the transport of lipophilic compounds as they support the skin penetration of active ingredients and thus increase their concentration in the skin which plays an important role in cosmetics product formulations. As a result, the characteristic of Nanoemulsion meets the fundamental process of formulating such products as body lotions, skin creams and sunscreens.

KEYWORDS: Nanoemulsion, cosmetic application, small droplet size, delivery system, pharmaceutical industry.

1. INTRODUCTION
Emulsion is defined as a dispersed system which consists of small droplets of dispersed of liquids (i.e. internal or discontinuous phase) which is well distributed in two immiscible vehicle. Emulsion is being applied in several of industries, such as food applications, pharmaceutical and cosmetics.[1] Since antiquity, emulsions are widely been used in cosmetics. In contrast to pharmaceutical ointments, cream and gels that can penetrate deep into the skin, cosmetic products are meant only for the immediate surface of the skin (i.e. the epidermis). The type of emulsions depending on their droplets size, which is the macroemulsion (droplet of 1 to 100 µm of diameter) also known as the conventional emulsion/colloid. It is commonly unstable with droplets sediment or floats with the dispersing phase and medium phase basically, unstable with absorption of solid particles on the surface. Emulsion system is a composed with appropriate ratio of oil phase, surfactant, co-surfactant and aqueous phase.[2] There are two type of emulsion application widely used in cosmetics independently of the globule size, which is the oil in water (O/W) emulsion used in general and hydrophilic drugs and water in oil (W/O) type of emulsion which applies as moisture for dry skin as shown in figure 1.[3] The characterization of emulsion type is shown in table 1. Microemulsion (droplet between 10-100 nm) is an isotropic liquid system with more uniform size and good physiochemical properties.[4]

Nanoemulsion (droplet size 20-200 nm diameter) is more stable and requires less emulsifying agent. The technological application of nanoemulsions have increasing used in various applications due to their characteristic properties of small droplet size (in the range 20-200 nm) with high interfacial area, transparent or translucent appearance, high solubilization capacity, low viscosity, and high kinetic stability sedimentation, flocculation, and in some cases, the coalescence.[5]

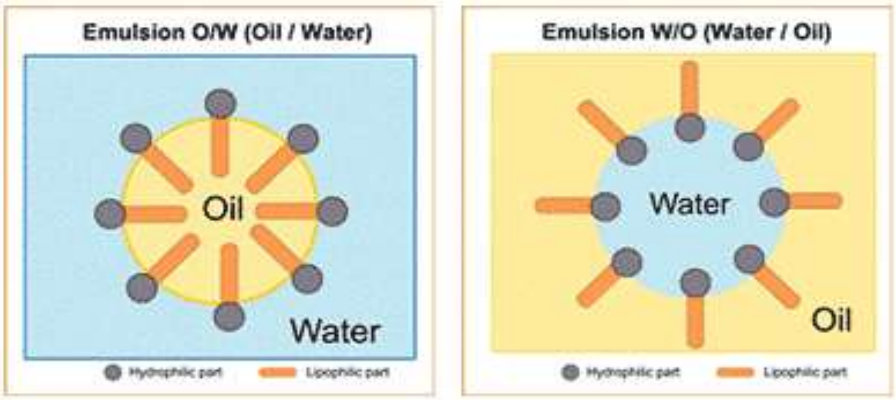

Figure 1: The hydrophilic part and lipophilic part of emulsion (O/W) and (W/O)

Table 1: The Characterization of Emulsion Type Based on Colour[6]

Type of Emulsion	Colour	Size	Characterization
Maroemulsion	Milik White	1 to 100 µm	Phase interfaces scatter light as it passes through the emulsion
Emulsion	White	1 to 100 µm	Phase interfaces scatter light as it passes through the emulsion
Microemulsion	Translucent bluish	10-100nm	Emulsion is dilute enough, higher-frequency and low-wavelength light will be scattered more, and the emulsion will appear bluer
Nanoemulsion	Translucent bluish	20-200nm	Emulsion is dilute enough, higher-frequency and low-wavelength light will be scattered more, and the emulsion will appear bluer

2. Emulsion delivery system in cosmetics

The delivery system in cosmetic industry comprises of microemulsion, liquid crystals, multiple emulsion and nanoemulsion. Nanoemulsion is a promising alternative to increase drug delivery system on regeneration and targeting the specific of poorly soluble drugs, increase absorption through the skin, better retention time of drug in the target area and eventually result in less side effects. The benefits of nanoemulsion with globules in nano-scale size of an emulsion does not relay on the emulsion physical properties itself, yet encounter the bioavailability of therapeutic drugs in whole.

Microemulsions are formulated for moisturizing formulation due to its occlusive, ease of removal from container, ease of application and adherence to treated area without tackiness. The ingredient contains di-decanoyl glycerol used to increase melanin content of melanocytes thereby increasing pigmentation of skin.[7]

Whereas, moisturizing effect and penetration of vitamin E is enhanced with the usage of microemulsion. Moreover, the efficiency of tri-decyl salicylic acid was increased when incorporated in microemulsion as an anti-ageing composition. Benzotriazoles, bisesorecinyl triazine and S-triazine added in microemulsion for photo-protective efficacy.[8] Microemulsion containing ascorbyl palmitate effectively prevents UV-A-induced lipid peroxidation.[7,9,10]

Emulsions containing liquid crystals have been observed to have a rate of active release much slower than those without this stabilizing component do. The effect is caused by multilayer structure of liquid crystalline material around droplet, which reduces the interfacial transport of the dissolved actives from within the droplet. For example, timed release of vitamin A palmitate containing liquid crystals dispersed in water-based gel.[11]

Multiple emulsions are emulsions in which globules of the dispersed phase encapsulate smaller droplets, which in most of the cases are identical with continuous phase. The two major types of multiple emulsions are W/O/W in which internal and external aqueous phases are separated by an oil layer and O/W/O in which water separates the two oil phases.[12] The most widely used type is W/O/W have potential applications in terms of controlled release systems for delivery of active ingredient, their use has been limited by lack of stability.

Emulsions consist of W/O and O/W emulsion requires at least two stabilizing surfactants, a low HLB one forming primary emulsion and a second, higher HLB surfactant to achieve the secondary emulsification. Primary emulsifiers are decaglycerol, decaoleate, mixed triglycerol trioleate and sorbitan trioleate. Secondary emulsifiers include polysorbates and poloxamers for W/O/W emulsion.[13]

Multiple emulsions are useful when one wishes to prepare sustained release aerosol fragrances, prolonged skin moisturizers and protection of sensitive biologicals, personal care formulations for perfumes, skin lipids, vitamins and free radical scavengers.[14,15] Polyphones are three liquid-phase dispersions, the internal phase being stabilized by encapsulation in a thin aqueous soapy film. Polyphones exhibit foam-like character in which the oil-encapsulated cells aggregate to form stable polyhedral structures. Dispersions containing 97% of dispersed oil phase within a continuous structure that contains only 3% water could be achieved.[16]

In another example, a five-phase novel emulsion consists of water, per fluorinated oil and liquid crystal dispersed in a continuous silicone phase along with coarsely dispersed aqueous gel phase.

3. Nanoemulsion in cosmetic

Nanoemulsion is widely used in the cosmetic industry due the active constituents are easily absorbed to give effective action base on its characteristic properties with a small size of the droplet and ability to reduce the water loss from the skin. Nanoemulsions are used as moisturizer, lotions and creams. Attractive delivery vehicle in the cosmetics nanoemulsion droplet size is very small, creaming and flocculation is not observed leading to a more elegant and thus facilitates uptake by antigen-presenting cells stable product formulations.

Nanoemulsion in cosmetic formulations provides a rapid penetration of active ingredients through skin due to the large surface area of droplets. Even sometimes it is found that nanoemulsion penetrate easily through rough skin. This property of nanoemulsion minimizes the additional utilization of special penetration enhancer which is responsible for incompatibility of formulation.[17]

Nanoemulsion formulation required low amount of surfactant compared to microemulsion. For example about 20-25 % surfactant is required for the preparation of microemulsion but 5-10 % surfactant is suffi-cient in case of nanoemulsion. Again with the help of nanoemulsion surfactant utilization can be minimized with a stable formulation.

4. The benefits of nanoemulsion in cosmetics

Nanoemulsions consist of very fine oil-in-water dispersions, having droplet diameter smaller than 100 nm. Compared with microemulsions, they are in a metastable state and are very fragile systems by nature. The structures depend on the process used to prepare them. They can be prepared by spontaneous emulsification such as phase inversion temperature (PIT) emulsification or phase inversion composition, or by using a high shear device, which allows a better control of the droplet size and large choice of compositions.[18]

Nanoemulsions can easily penetrate in skin because it has good sensorial properties with rapid penetration, merging textures and its biophysical properties especially the hydrating capacity. The formulation may lead to a large variety of products from water-like fluids to ringing gels, lotions, transparent milks, crystal-clear gels with different rheological behaviors, visual aspects, richness and skin feel are formulated.[19]

Furthermore, there is a significant improvement in dry hair aspect (after several shampoos) is obtained with a prolonged effect after a cationic nanoemulsion use. Hair becomes more fluid and shiny, less brittle and non-greasy.[13]

5. The disadvantages of nanoemulsion and the overcoming strategy

Nanoemulsion is relatively an attractive system for many industrial application due it their purity, simplicity and the ability to sterilize through filtration and the capacity of increase bioavailability of drug solubilized in them.[15] Nevertheless, the nanoemulsion is clearly constitute with many benefits but some authors describe that nanoemulsion r < 100nm are thermodynamically not stable and leads the respective system to breakdown with various instability mechanisms in it.[16]

Moreover, nanoemulsion has only kinetic stability, in long-term, it is sometimes stated to as 'nearing thermodynamic stability' because of the absence of flocculation.[17]

Small droplet size of nanoemulsion also contributes to irreversible destabilization as a result of the mechanisms of Ostwald ripening or coalescence. When smaller droplets dissolved and redeposit on larger particles to influence decreasing droplet's radius.[17]

Therefore, Ostwald ripening effects the continuous small-scaled droplet size, nanoemulsion exhibited a growth in droplet size with time.[17] Polymeric surfactants in O/W nanoemulsions have been used to reduce Ostwald ripening whereby strongly absorbed at the O/W interface, modifying interfacial tension, and increased the Gibbs dilatational elasticity. By adding an insoluble surfactant in the dispersed phase, nanoemulsions can be stabilized against Ostwald ripening. It has also been reported that for an ethoxylated nonionic surfactant system, addition of a second surfactant with the same alkyl chain length and higher degree of ethoxylation than the primary surfactant led to a reduction in Ostwald ripening rate. The rate of Ostwald ripening can be retarded by storing the nanoemulsions at optimum temperature as it follows the Arhenius law of reversing temperature. By adding squalene into the O/W nanoemulsion results in reducing Ostwald ripening rate due to the decreasing solubility of the oil phase.

CONCLUSION

Nanoemulsions are non-equilibrium, thermodynamically stable optically transparent, metastable dispersion of nano-sized particles having defined surface tension

formed by certain shear, comprises of a suitable oil and definite blend of surfactants and co-surfactants. The stabilization system possesses the stability sedimentation or creaming. In addition, breakdown of the particles into nano-scaled sizes, the system has the ability to attain low polydispersity. The physicochemical and biological properties of nanoemulsion deviate from the classical emulsion properties. Nanoemulsion system can be achieved through homogenizers, low energy emulsification and phase inversion temperature methods. On top of that, there are so many conflicts regarding suitable method of preparation of nanoemulsions and later on it was proved that nanoemulsions can be formulated by low-energy emulsification method along with high shear homogenizer method.

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