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천연 Oleosomes를 이용한 에멀젼 기술

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Natural Oleosomes Loading Emulsion Technology
-Loading Oleosomes as Delivery Systems for Improved Cosmetic Efficacies-

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요 약: 천연물 유래의 잇꽃 oleosomes은 미래 에너지 자원으로 사용되며 씨 안쪽에 트리그리세라이드를 저장한 작고(1 ~ 3 μm) 둥근 모양의 저장소이다. Oleosome의 표면은 고분자의(20~24 KDa) oleosin 단백질로 덮여 있으며 유화 특성을 나타낸다. 전통적으로, 잇꽃처럼 오일을 내포하고 있는 씨앗의 oleosomes은 내부에 있는 오일을 분리하기 위하여 단순히 분쇄하는 방법을 사용하였다. 특허 받은 DermaSphere 기술은 손상되지 않은 상태의 oleosomes의 분리가 가능하다. 분리된, 이 원료는 일반적으로 잇꽃 오일과 관련된 피부 유연제, 보습제, 산화 방지제들을 전달하는 제형에 사용될 수 있다. 그러나, 현재의 에멀젼화된 oleosin 단백질이 둥근 오일 바디를 덮고 있기 때문에, oleosomes은 전형적인 oil-in-water (O/W) 유상액에서 다른 oil phase를 에멀젼화 할 뿐만 아니라 자기 유화 특성도 가지고 있다. Oleosomes은 화장품 제형에서 유상의 비 활성 부분으로 역할을 하고 있다. 천연 oleosomes은 다양한 유상 활성 성분들을 포집할 수 있으며 화장품 효능 증진을 위한 전달 시스템으로 사용 될 수 있다. 또한, Oleosomes은 방향제, 비타민, 방충제, UV chromophores 같은 다양한 물질들을 포집 할 수 있었다. 이러한 oleosomes은 제품내에 있는 활성물질들을 보호하거나, 시간이 경과에 따른 활성물질의 적절한 방출을 제어하는데 사용 될 수 있다.

Abstract: Natural safflower oleosomes are small (1 ~ 3 μm) spherical shaped "reservoir", inside which the seed stores triglycerides for use as a future energy source. The surface of the oleosome is covered with a high molecular weight (20 ~ 24 KDa) oleosin protein which has been demonstrated to have emulsification properties. Traditionally, oleosomes from oil bearing seeds such as safflower were simply crushed to liberate the oil within. Our patented DermaSphere technology allows for the isolation of oleosomes in the intact state. Once isolated, these materials can be used in skin care formulations to deliver the emolliency, occlusivity, and anti-oxidant effects typically associated with safflower oil. However, because of the presence of the emulsifying oleosin protein covering the spherical oil body, oleosomes have self-emulsification property as well as can emulsify other oil phase in typical oil-in-water (O/W) emulsion. The oleosomes can literally serve as the entire non-active portion of the oil phase of a typical skin care product. Most importantly, natural oleosomes can be loaded with other oil-soluble active materials and can therefore be used as delivery systems for improved cosmetic efficacies. Oleosomes can be loaded with various actives, such as fragrances, vitamins, inset repellents, and UV chromophores. The loaded oleosomes can be utilized to either protect the active ingredients within the formulation itself or to allow for control release of those actives over time.

Keywords: *safflower seeds, oleosome, moisturizing, loading capability, cold processing*

1. Oleosome Technology

All plant seeds that store triglycerides sequester these oils in specialized organelles called oleosomes. A diagram of a typical safflower oleosome with its triglycerides fatty acid distribution is shown below in Figure 1.

Spherical in shape and one to three microns in

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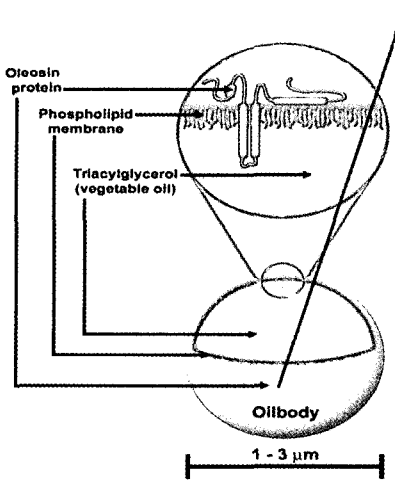

Fatty acid	%
Myristic	0.06
Palmitic	4.64
Palmitoleic	0.13
Stearic	2.14
Oleic	76.36
Linoleic	15.08
Linolenic	0.05
Others	1.54

Figure 1. Structural depiction of a plant oleosome with oleosin proteins covering its surface. In the above structure, the hydrophobic portion of the protein is represented by the thick area and the hydrophilic portion is represented by the thinner portion.

diameter the oleosome consists of an inner reservoir of triglycerides, surrounded by a phospholipid layer, which in turn is surrounded by unique proteins called oleosins.

The oleosin protein is unique in that it is made of both hydrophilic and hydrophobic portions, in which some of the hydrophobic portion penetrates into the inner triglyceride core and serves as an anchor. The remainder resides on the surface of the oleosome. This amphophilic nature of the protein coat is what gives the oleosomes their unique self-emulsifying/emulsifying capabilities.

Inside of oil body reservoir, triglycerides contain high level of unsaturated fatty acids. Because of the unique spherical structure of oleosomes, those triglycerides containing high unsaturated fatty acids can impart valuable cosmetic benefits, such as cushion, skin feels and etc. without oxidation or degradation issues in relating to those unsaturated fatty acids in traditional emulsion systems.

2. Loading Oleosomes

Oleosomes can be loaded with various oil soluble materials. Loading such materials can be used to deliver the synergistic effect of protected active ingredients within the formulation itself or to allow using as the delivery systems for controlled release of these materials over time. Figure 2 is a photomicrograph of safflower oleosomes which have been loaded with a tocopherol acetate/carotene blend for 24 h and then subjected to 10 extractions with hexane.

Table 1. Oil Phase Ingredients Loaded into Oleosomes

Oil phase ingredient	% Loaded
Tocopherol acetate	30
Octyl p-methoxycinnamate	30
Octyl salicylate	25
Methyl salicylate	8
Diethyl toluamide	10
Butyl methoxydibenzoyl methane	5

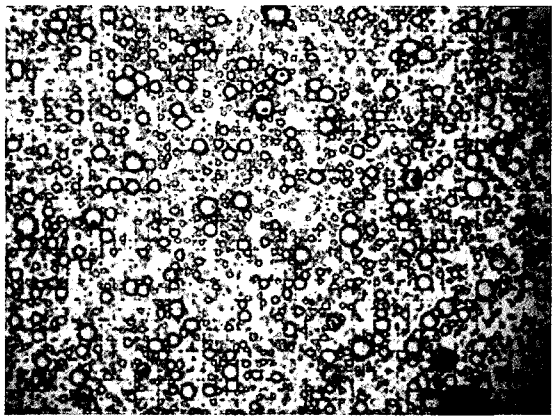

Figure 2. Beta-carotene loaded oleosomes.

A number of different oil soluble materials have been loaded into the safflower triglyceride containing core

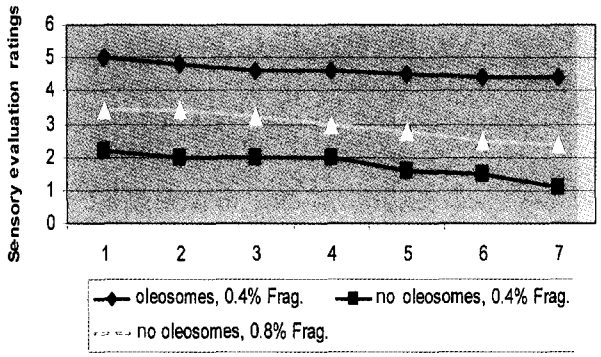

Figure 3. Fragrance retention study.

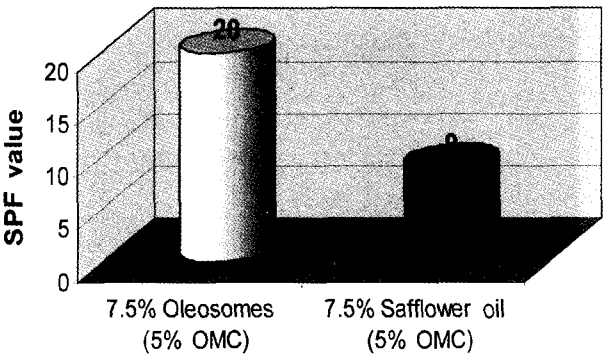

Figure 4. Loaded sunscreens oleosomes for improved SPF efficacy.

without disrupting the oleosome structure. Some examples of materials which have been loaded are outlined in Table 1 along with the maximum loading levels achieved.

Loading levels of oil soluble materials depend upon a number of factors, such as the molecular weights of actives, the formulation viscosity and pH, the charges of the actives, as well as the other ingredients in the formulations.

Once loaded with the oil soluble ingredients, the oleosomes showed remarkable stability.

Hypothetically, release of the active materials from the oleosome can occur in a number of ways:

1) exchange with other oils in the formulation
2) rupture of the oleosomes upon application to the skin
3) exchange with the sebum in the skin
4) evaporation, in the case of volatile materials

Table 2. Enhanced SPF Oleosome Emulsion Formulation

Oleosome sunscreen emulsion (~SPF 32)	
Ingredients	Weight %
Oil phase	
Safflower oleosomes (Natrulon® OSF)	12.00
Octyl methoxycinnamate	1.00
Octocrylene	0.50
Ethylhexyl salicylate	0.50
Benzophenone-3	0.50
Titanium dioxide	2.00
Novemer EC-1	1.10
Water phase	
Urea	5.00
Polyglycerin-10 (Natrulon H-10)	5.00
Water	To 100
Phase C	
Fragrance	0.14
Preservative	0.40

3. Cosmetic Efficacies of Loading Oleosomes

3.1. Fragrance Retention

Oleosomes with Fragrance retention studies were conducted, in which a standard moisturizing formulation without oleosomes compared with the formulation containing 10% oleosomes in a double-blind panel study. This clearly shows the advantages of loading volatile materials into the oleosomes. The study indicated that the oleosome-containing formulation resulted in higher fragrance levels, even higher then the no oleosome formulation with twice the level of fragrance.

3.2. SPF Enhancement for UV Protection

The loaded oleosomes can be used as the delivery system to further improve the cosmetic efficacies. When the oleosomes loaded with sunscreens, the enhanced SPF values for sun protection were observed. The SPF evaluation studies were conducted based on the in-vitro measurements by a UV spectrophotometer. As indicated in the following graph, the SPF value enhanced more than double with the oleosome emulsion compared with non-oleosome emulsion.

As demonstrated in the following formulation example, small amount of sunscreen actives in combining organics and inorganic actives will provide much more enhanced SPF value for UV protection with oleosome emulsions. Furthermore, with less UV chromospheres

in the formulation, it will greatly increase the formulation aesthetics, less irritation profile as well as cost effective.

4. Conclusion

Natural oleosomes technology not only provide novel Oleosome Emulsion concept, but also it has the ability to be loaded by other oil phase actives, such as fragrances, vitamins, and UV filters as delivery systems for better cosmetic efficacies. When the oleosomes loaded with sunscreens, the cosmetic benefits are:

- Enhanced SPF value for improved the sun protection efficacies with long lasting, long protection, and water resistance
- Loaded oleosomes can deliver these actives to the skin in a control release fashion over time
- Reduce the UV chromophores for improved irritation profile and more cost-effective formulations
- No or less emulsifiers required for better water repellency and less irritation formulations
- Mitigation of the octyl methoxycinnamate/avobenzone Interaction
- Improved formulation aesthetics

In conclusion, oleosomes constitute a novel emulsion concept and a true multifunctional ingredient, providing emolliency, occlusivity, emulsification, anti-oxidant effects as well as controlled release/delivery system to improve the cosmetic efficacies for skin are applications.

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