

Triple Matrix Capsulation having Visible Effects and Stabilizing Functions

In-Young Kim[†] · Bo-Reum Seong · Min-Hee Lee

*Biobeautech Co., Ltd., Research and Development Center
R306 Biz-Dong, SKn-TechnoPark, 124 Sagimakgol-ro, Jungwon-gu, Seongnam-si,
Gyeonggi-do, 462-721, Seoul Korea*

(Received May 31, 2015; Revised June 20, 2015; Accepted June 20, 2015)

Abstract : This study is to develop the double capsulation technology in order to increase the conservativeness and stability of unstable materials such as vitamins, polyphenols, natural active ingredients. And also, best way of triple matrix capsulation using natural polymers were detail described. As the first capsulation with w/o/w (water-in-oil-in-water) emulsifying system, our study group was especially made to soft and moisture cream using 5wt% of sucrose ester emulsifier as first capsulation. Nutrient agents are squalane, camellia oil. Triple matrix capsulation was formed with the best stabilized bead type capsules when it blended of chitosan, algin, sodium-potassium alginate. The bead diameter size was about 2.0~4.5mm (mean diameter: 3.2mm). Activity of lactobacillus containing cream for depending on various pH variations showed that alkalinity (pH=10.8±0.5) condition was higher than acidity (pH=4.2±0.2) and neutrality (pH=7.1±0.3) conditions. After a month, it also was certified to the activity of lactobacillus in incubated at 37±1° C in culture medium. As application of food industry, we developed the containing lactobacillus capsule and 7 colored kinds of double and triple matrix capsulation in yogurt cream and active ingredients. As for above mentioned those results, one of tool to stabilize the living lactobacillus, doubled matrix capsulation greatly be expected to contribute to food industry. Furthermore, it can be expected to apply the drug delivery system (DDS) to active ingredients of stabilizing technologies at drug, pharmaceutical division and cosmetic industry, etc.

Keywords : Triple matrix capsule, bead, skin care, cosmetics, delivery system, stability

1. Introduction

Stabilizing technology in cosmetic industry, water moisturizing activity and oil balance is one of the most important functions of skin care cosmetic field [1]~[3]. But, in specific

formulas and technologies such as toner, essence, and skin lotion having a water/oil balance without visible effects, it is not easy to find the skin care cosmetic fields having multi-functional activity such as moisturizing, whitening, TEWL and anti-aging efficacy [4]~[7].

Recently, various high functional cosmetics have been launching having multi-functional

[†]Corresponding author
(E-mail: iykim200@naver.com)

effects such as skin care and make-up care cosmetic fields [8]~[10]. Also, PIT technology of Korea is to be significantly extended with a major trend in the world market[11~[13].

Regarding the visible triple bead capsulation methods, they have been developing form ten years ago. In this study, we tried to study regarding the new method maintaining stability of unstable active ingredients, to make the long-term preservation through the doubled or tripled encapsulation[14]~[17]. Firstly, as the first capsule, we tried to develop the incorporated in nutritive w/o/w emulsion cream containing active ingredients, then we make a tripled matrix capsulation using chitosan, algin, sodium-potassium alginate natural polymers in order to increase the long-term stability even though room temperature. To make the tripled matrix capsulation, depend on various pH changes, was examined. And also, the various encapsulation of a variety of colors as the application were carried out. Therefore, this study can be contributed to the development of new tools applying advanced unique stabilizing technique with drug delivery system (DDS) in food and pharmaceutical industries.

2. Methods

To make the first capsule sucrose ester cream was described as follows (Fig. 1). The composition of the cream containing lactobacillus containing 5wt% of a sucrose ester, 3wt% of stearic acid, 5wt% of camellia oil, 2wt% of squalane, 0.5wt% of the tocopherol was used, and also, to make a matrix capsule applied the glycerol, chitosan, algin, sodium and potassium alginate.

Double or triple matrix capsules were prepared by the following procedure. The composition was prepared as a cream containing active ingredients that passes through a device was able to make a stable matrix capsules. Primary encapsulated in a soft

w/o/w cream, put the device moved to a closed vessel, and then, injected air into the low pressure through a small nozzle with a needle to fall drop by drop through. At this time, the prepared solution of 5% of sodium chloride, calcium chloride, calcium sulfate, 5wt% of ethanol solution dropped on a hard capsule is formed.

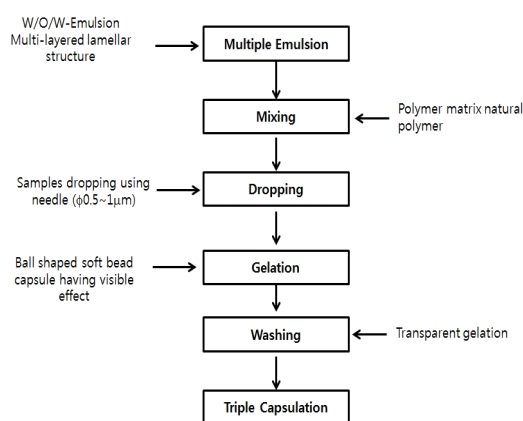


Fig. 1. Manufacturing method of tripled matrix capsulation; first and second capsulation is used with w/o/w emulsion and multi-layered capsules, tripled matrix capsule is applied with natural polymer matrix polymer.

3. Results and Discussion

3.1. Merits of Triple Matrix Capsule

There are various merits and benefits through stabilizing system of double matrix capsule of active ingredients. Applying algin, chitosan and sodium-potassium alginate were merit that is possible to eat because of natural food grade. Chitosan is good stable although it is acidic and alkaline conditions. Chitosan has known that is a good safety, stable material which has excellent in moisture-retaining effect and excellent anti-oxidative activity. As the physical properties of chitosan, they are generally insoluble in water. But it can be dissolved maintaining above pH=10.8 in citric

acid solution, acetic acid solution, hydrochloric acid solution of small content due to form a salt.

3.2. Triple Matrix Capsulation

Preparing method of triple matrix capsule was carried by next process (Fig. 1). In order to make a capsule applied our specific order made device from Biobeatech co., ltd. The needles were specifically produced in order to get look good shape and various color. To make a small size bead capsule needs various diameter needle. First, the size of millet circular in order to make the beautiful color capsule, the inner diameter of the needle diameter was produced about 0.5mm size. In order to form a stable double matrix membrane capsule, we made 500mL with containing a 5wt% solution of calcium chloride, calcium sulfate, 5wt% ethanol solution and sodium citrate. The pH was $\text{pH}=10.8 \pm 0.3$.

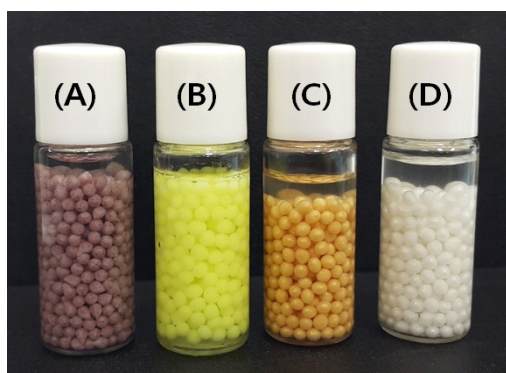


Fig. 2. Photos of various matrix capsule containing anti-oxidative active ingredients; (A) Resveratrol, (B) Idebenone, (C) Vitamin E, and (D) Niacinamide.

We finally produced various capsules having various colors in order to wonderful seeing and beautiful images as Fig. 2. (A) is brownish colored capsule containing resveratrol which is strong anti-oxidative effect. (B) is

yellowish colored capsule containing idebenone which is whitening activity and diminish pigment on skin. (C) is gold colored capsule containing vitamin-E (natural tocopherol) which is anti-aging activity and anti-oxidative activity. (D) is gold colored capsule containing niacinamide which is anti-aging activity and anti-oxidative activity.

4. Conclusion

In this study, we developed the various color matrix capsule having visual effect and stabilizing technology of unstable active ingredients to differentiate and give way to a triple matrix, suggesting encapsulation. First, the primary and secondary capsulation method of encapsulating 5wt% of sucrose ester using the cream was able to make soft and moist. Second, the secondary matrix capsule chitosan and alginate is a mixture in a ratio of 1:3 most stable when encapsulated in the capsule is formed. The size of the capsule matrix 3mm to form a bead surface is smooth and could make solid.

Major capsules such as brownish colored capsule containing resveratrol, yellowish colored capsule containing idebenone, gold colored capsule containing vitamin-E (natural tocopherol) which is anti-aging activity and anti-oxidative activity, silver colored capsule containing niacinamide which is anti-aging activity and anti-oxidative activity.

These results suggested that, in the method for stabilizing ways as a tool, tripled matrix capsule is expected to greatly contribute to the cosmetic industry, pharmaceutical industry, furthermore through the encapsulation of insulin drug delivery systems (DDS), and the active ingredients in the cosmetic industry in the application of this stabilization technique are expected to be possible.

Acknowledgements

This study was performed by R&D fund from Korea small and medium business administration. (Project No. : S2210270, Major Company: Biobeautech Co., Ltd)

References

1. S. Kumalaningsih, M. Padaga, Suprayogi, V. Rizky P, International Research Journal of Agricultural Science and Soil Science, **1**(7), 273–290 (2011).
2. Benjamin F. Hammond, Burton Rosan and Ned B. Williams, J. Bacteriol., **88**(6), 1807–1811(1964).
3. S. J. Kim, S. Y. Cho, S. H. Kim, O. J. Song, I. S. Shin, D. S. Cha, H. J. Park, LWT, **41**, 493 (2008).
4. A. Sohail, M. S. Turner, A. Coombes, B. Bhandari, Food and Bioprocess Technology, **6** (10), 2763(2013).
5. L. E. Shi, Z. H. Li, Z. L. Zhang, T. T. Zhang, W. M. Yu, and M. L. Zhou, LWT–Food Science and Technology, **54**, 147 (2013).
6. Jung-il Kim, Hyun-dong Kim, J. of Korea Oil Chem. Soc., **31**(4), 623–627 (2014).
7. Ki-Chun Kang, Noh-Hee Jeong, J. of Korea Oil Chem. Soc., **30**(1), 152–159 (2013).
8. K. H. Son, Y. O. Kim, J. P. Lee, S. J. Yang, O. J. Baek, W. H. Kim, J. G. Kim, M. Y. Heo, S. S. Choi and J. G. Lee, J. Soc. Cosmet. Scientists Korea, **28**(3), 171(2002).
9. [3]. J. C. Yang, J. of Korean Oil Chemists' Soc., **27**(3),370(2010).
10. T. Ito, Y. Tsuji, K. Aramaki, and N. Tonooka, *J. Oleo. Sci.*, **61**(8), 413(2012).
11. J. M. Morais, P. A. Rocha-Filho, and D. J. Burgess, *Langmuir*, **26**(23), 17874 (2010).
12. I. Y. Kim, J. of Korean Oil Chemists' Soc, **17**(2), 67(2000).
13. J. Jiao and D. J. Burgess, AAPS Pharmsci., **5**(1), E7 (2003).
14. T. Gao, J. M. Tien, Y. H. Choi, **118**(10), 41(2003).
15. S. Y. Ahn, J. H. Bae, H. K. Lee, S. J. Moon and I. S. Chang, J. Soc. Cosmet. Scientists Korea, **30**(1), 129 (2004).
16. J. C. Yang, J. of Korean Oil Chemists' Soc., **27**(3), 370(2010).
17. Z. Yuan, Z. Yin, S. Sun, J. Hao, J. Phys. Chem. B, **112**, 1414 (2008).