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Retinal Stabilization Study using Three-dimensional Bio Printing

Ja-In Kim[1], Seung-Yeon Son[1], Yu-Jin Kang[1], Young-Ah Park[1], Hong-Geun Ji[1], Dong-Ock Kim[1]
H&A pharmachem, R&D center

Introduction:

Three-dimensional bioprinting(3DP) is a revolutionary technique that uses computer aided design software and programming to create three dimensional objects by placing material on a substrate. 3DP is an additive layer manufacturing techniques, where consecutive layers of material are deposited or solidified to form a Three-dimensional structure.[1] 3D bioprinting methods have been applied to various fields, including those associated with tissue and organ regeneration, artificial skin, and medicine. Additive manufacturing is leading towards personalised medicine as the dosing and release characteristics of the drug delivery devices can be easily changed by altering the geometries of the Three-dimensional design using computer-aided design (CAD).[2] Retinal is one of important vitamins with a wide variety of biological functions such as embryonic growth and development, vertebrate vision, immune reactions, and epidermal differentiation. However, It is also well-known that the environmental conditions such as high humidity, low pH and high temperature significantly decrease the stability of retinal and its relatives. In this study, the retinal was printed as a solid formulation using a 3D bioprinter, and the stability of the retinal was increased with the solid formulation.

Materials & Methods:

Measure sample A,B in a glass beaker.Melt it completely at 80°C Load the sample A,B into a 10mL syringe. Maintain the syringe temperature at 40°C to ensure sample A,B remains at the highest density for a liquid solution. CADian CAD(INTELLI Corp, Seoul, Korea) was used to design the 3D model. For compatibility with a 3D printer (ROKIT INVIVO Corp., Seoul, Korea), 3D structure files were converted to G-Code in slicer settings by NewCreatorK software (ver. 1.57.76, ROKIT INVIVO Corp., Seoul, Korea). Form a 3D structure to be printed with CAD programs and save it in an STL file. Accomplish the slicing process through the use of slicer software and generate the corresponding G-code file. Start printing according to the output conditions.

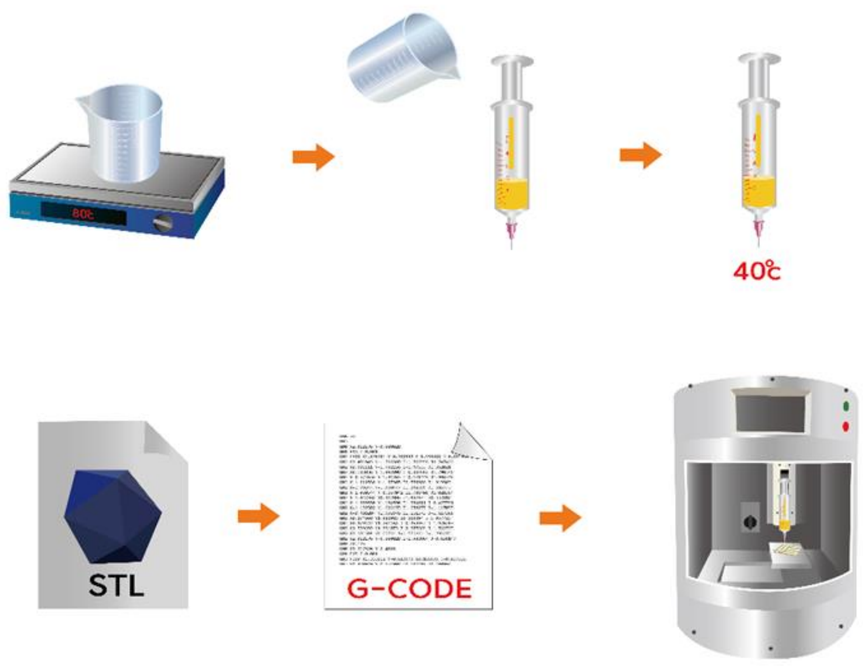

Fig-1. 3D bio printing process

Results & Discussion:

In this study, the retinal was printed as a solid formulation using a 3D bioprinter, and the stability of the retinal was increased with the solid formulation. The two solid retinal formulationswere printed with a 3D printer.The results of the SEM measurement of the retinal solid formulation printed by 3D bioprinting showed a clearly visible surface with individual layers for both Sample A and Sample B. The results of the DSC measurement did not show any retinal-related peaks in Solution A-2 or Solution B-2 that contained retinal. This indicated significant physicochemical interactions between the components of the mixture formulation .As a result of the HPLC measurement, both sample A and sample B had stability while maintaining a certain concentration of retinal at all temperatures.This suggested that 3D bioprinting technology can be used as a new method to stabilize retinal and can therefore be applied to various fields such as cosmetics and pharmaceuticals.

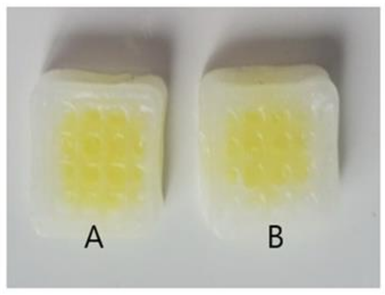

Fig-2. Images of the 3D printed Retinal 3DP dosage forms

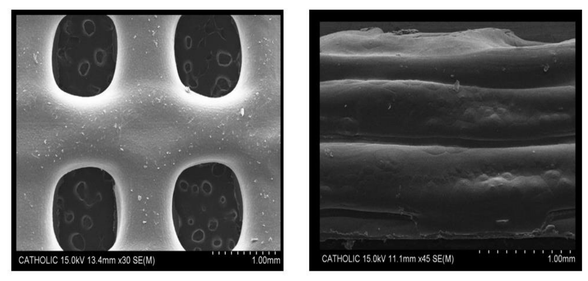

Fig-3.Scanning electron microscopy (SEM) images of the 3D printed Retinal 3DP dosage forms

Conclusions:

Retinal is one of important vitamins with a wide variety of biological functions such as embryonic growth and development, vertebrate vision, immune reactions, and epidermal differentiation. It is also prime candidate for cancer chemoprevention. However, it is known that the stability of vitamin A decreases under high temperature, high humidity, and low pH conditions. Many studies have been conducted to improve the stability of retinal when exposed to air, heat, and light. Therefore, it is essential to develop new technologies to stabilize retinal. In this study, retinal was output as a solid formulation using 3D bioprinting. The results showed that the stability of the retinal solid formulation printed by 3D bioprinting had been improved. This suggested that 3D bioprinting technology can be used as a new method to stabilize retinal and can therefore be applied to various fields such as cosmetics

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