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Original Article

MORPHOLOGY STUDY OF PLAI PATCH BY THE SCANNING ELECTRON MICROSCOPE. PART I: CHITOSAN AND HYDROXYPROPYLMETHYLCELLULOSE BLENDS

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ABSTRACT

Objective: The compound D or (*E*)-4-(3', 4'-dimethoxyphenyl)-but-3-en-1-ol is the main active chemical constituent in *Zingiber cassumunar* Roxb. (Plai) used for the treatment of asthma, for muscle and joint pain. This research aimed to study the surface morphology of Plai patch after *in vitro* release study of compound D. This patch made from polymer blends consisted of chitosan and hydroxypropylmethyl cellulose using glycerine as plasticizer.

Methods: The crude Plai oil was dissolved in absolute ethanol and homogeneously mixed into the polymer blends solution consisted of chitosan, hydroxypropylmethyl cellulose, and glycerine, and then dried in hot air oven to produce the Plai patch. The Plai patch was placed into Franz cell diffusion apparatus for 24 hours. After that, the Plai patch was photographed by scanning electron microscope (SEM) to study the morphology of this patch after compound D release.

Results: The morphology of the Plai patch after the release of compound D was visualized by SEM. The morphology of Plai patch made from polymer blends between chitosan, hydroxypropylmethyl cellulose, and glycerine had various numbers of pores, suggesting that the release of compound D occur mainly in patch surfaces and its might diffused through the matrix pores due to the active compound solubilization in the receptor medium, isotonic phosphate buffer pH 7.4: ethanol = 8:2.

Conclusion: When the Plai patch absorbed the moisture and fluid from receptor medium, the Plai patch might swell and release the compound D, main active compound in Plai from this patch. This might contributed the pore in Plai patch.

Keyword: Morphology study, Plai, Patches, HPMC.

INTRODUCTION

Patches are the medicated device adhesive that is placed on the skin to deliver a drug or active compound of medication (I) into the skin (dermal patch or skin patch), or (II) through the skin and into the bloodstream (transdermal patches). The patches can control a drug or active compound of medication into the patient through (I) porous matrix membrane in term of drug in adhesive type, (II) porous matrix membrane and adhesive layer in term of drug in matrix type, and (III) controlling membrane and adhesive layer in term of drug in reservoir type [1-3]. In 1979, the U.S. Food and Drug Administration approved the first commercially available prescription patch which is scopolamine patches for motion sickness.

Compound D, (*E*)-4-(3', 4'-dimethoxyphenyl)-but-3-en-1-ol (Figure 1), an active constituent isolated from Plai (*Zingiber cassumunar* Roxb.) is a bronchodilating compound that reported to be an anti-inflammatory agent. It is used as a reference standard for analytical method which is reported in our previous publication [4-6].

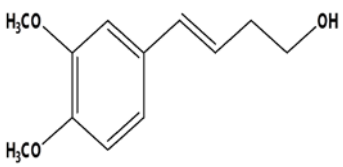

Fig. 1: Chemical structure of (*E*)-4-(3', 4'-dimethoxyphenyl)-but-3-en-1-ol (compound D)

This work mainly studied the morphology of Plai patch which incorporated the crude Plai oil into polymer blends solution between chitosan, hydroxypropylmethyl cellulose, and glycerine. This Plai patch was studied the *in vitro* release of compound D for 24 hours by Franz cell diffusion apparatus having the isotonic phosphate buffer pH 7.4: ethanol = 8:2 as receptor medium. The Plai patch was photographed by scanning electron microscope (SEM).

MATERIALS AND METHODS

Materials

Plai powder was purchased from Charoensuk Osod, Thailand. Chitosan powder was purchased from Seafresh Industry Public Co., Ltd, Thailand. Hydroxypropylmethyl cellulose was purchased from Onimax, Thailand. Glycerine was purchased from Sigma-Aldrich, USA. All organic solvents were of analytical grade obtained from Merck KGaA (Germany). The ultrapure water was produced by Puris, Expe-UP water system (model: Expe-UP series, Korea) that had been purified to stringent specifications with 18.2 MΩ·cm at 25ºC of resistivity, 5 – 10 ppb of total organic carbon (TOC), <0.05 ppb of inorganics, and <1 cfu/mL of bacteria.

Plai patch preparation

The Plai patch was made from crude Plai oil mixed into polymer blends solution of chitosan, hydroxypropylmethyl cellulose, and glycerine. The polymer blends composition was prepared by 2 g of 3.5%w/v chitosan in distilled water comprised of 1% acetic acid, 5 g of 20%w/v hydroxypropylmethyl cellulose in distilled water, and glycerine as plasticizer, and then it was mixed together with crude Plai oil. After that, they were transferred into Petri-dish and dried in hot air oven at 70±2ºC for 5 hours.

The *in vitro* release studies

The Plai patch was studied the *in vitro* release behavior of compound D using a modified Franz-type diffusion cell having isotonic phosphate buffer pH 7.4: ethanol = 8:2 as receptor medium, controlled with a water jacket at 37±0.5ºC, and constantly stirred at 600 rpm with a magnetic stirrer for 24 hours. However, this work reported only the surface morphology of Plai patch after compound

D release from Plai patch. Thus, the *in vitro* release profile of compound D might be reported in future publication.

SEM photography

The Plai patch from *in vitro* study for 24 hours was placed onto copper stub and then was coated with gold in a sputter coater. It was photographed surface of Plai patch under SEM (model: Quanta 400, FEI, Czech Republic) with high vacuum and high voltage of 20 kV condition, and using everhart thornley detector (ETD).

RESULTS AND DISCUSSION

The appearances of Plai patches made from polymer blends consisted of chitosan and hydroxypropylmethyl cellulose using glycerine as plasticizer was photographed by digital camera (Figure 2).

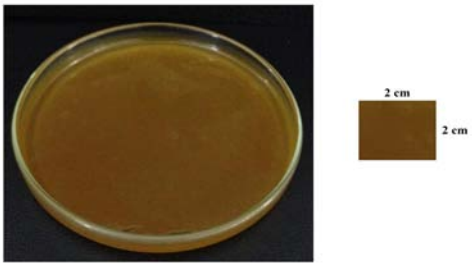

Fig. 2: The appearances of Plai patch made from polymer blends between chitosan and hydroxypropylmethyl cellulose using glycerine as plasticizer photographed by digital camera, this picture was modified from previous publication [5].

Before *in vitro* release of compound D, the surface of Plai patch made from polymer blends consisted of chitosan and hydroxyl propylmethyl cellulose using glycerine as plasticizer that photographed by SEM technique was represented in previous publication [5]. This picture can confirmed the crude Plai oil, mainly compound in Plai entrapment in Plai patch was made from chitosan and hydroxypropylmethyl cellulose using glycerine as plasticizer.

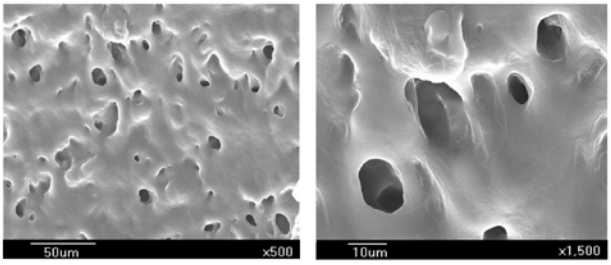

Fig. 3: The surface appearances of Plai patch made from polymer blends between chitosan and hydroxypropylmethyl cellulose using glycerine as plasticizer at ×500 (left) and ×1,500 (right) under SEM study

After *in vitro* release of compound D, 24 hours, this work, many pores were found in surface morphology of Plai patch under SEM photography (Figure 3). This is due to the compound D release from Plai patch. When the Plai patch absorbed the receptor medium (isotonic phosphate buffer pH 7.4: ethanol = 8:2) in patch, the Plai patch might swell and release the compound D from patch. Thus, we could found many pores in patch which are shown in Figure 3. However, the release behavior of compound D from this Plai patch might be reported in future publication.

CONCLUSIONS

We successfully prepared the Plai patch made from polymer blends consisted of chitosan and hydroxypropylmethyl cellulose using glycerine as plasticizer. It had dark yellow Plai patch under digital camera. When the compound D, mainly compound in Plai released from patch, this Plai patch had many pores that photographed by SEM method. Moreover, the *in vitro* release study for this Plai patch might be reported in further study.

CONFLICT OF INTERESTS

Declared None

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NOTE

This report was related with another publication by our group research in entitle of "MORPHOLOGY STUDY OF PLAI PATCHES BY THE SCANNING ELECTRON MICROSCOPE. PART II: CHITOSAN AND POLYVINYL ALCOHOL BLENDS".

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