

以半乳糖黏附導向之光動力療法治療紅色毛癬菌之感染
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摘要：

台灣屬於副熱帶型的氣候，溫暖潮濕的氣候容易形成各類真菌的溫床。真菌主要分為兩種，黴菌和酵母菌，而在生活中最讓大眾熟知的香港腳，就是屬於黴菌感染的一種疾病，香港腳正式名稱叫做足癬，是一種叫做紅色毛癬菌的黴菌感染造成的了，以足癬而言，多數的病患，除了腳趾間的表皮鱗屑外，並無主觀的不適症狀，部分的患者，可能會有糜爛、紅腫，伴隨刺癢和難聞的氣味等症狀，嚴重時可能會造成灰指甲，指甲剝落等等，甚至可能給其它後續細菌的二次感染的突破口，導致蜂窩性組織炎，最嚴重可能會有截肢的風險存在。

治療紅色毛癬菌的方式，醫生通常會透過非處方抗真菌藥膏進行治療，其中主要抗菌成份，例如：Terbinafine (特比萘芬，療黴舒乳膏的主要抗菌成份)、Clotrimazole (克黴唑，黴克頓乳膏的主要抗菌成份) 是干擾黴菌細胞膜中麥角固醇 (Ergosterol) 的合成，使細胞逐漸凋亡，但即使殺死黴菌本身，只要有菌絲體沒有完全清除乾淨，便容易復發給人們造成困擾。

本研究的目的是，就是希望可以透過光動力療法，作為一種新的治療手段，光動力療法的原理就是選擇一種光敏劑，並以特定波長的激發光進行激發，將其從基態變成激發態後，在釋放能量的過程中，當患部周圍的氧氣和生物分子吸收之後就會分別變成單支態氧 (1O_2) 和過氧化物 (ROS)，會對患部造成毒殺黴菌的效果，以達到治療的目的。而本研究針對紅色毛癬菌對於半乳糖會造成細胞黏附的特性，將半乳糖修飾於殼聚糖 (chitosan)，再和 tripolyphosphate (TPP) 進行陰陽離子交聯反應，並包覆薑黃素 (curcumin) 作為光敏劑，以解決薑黃素水溶性不佳的問題，而後以藍光作為激發光，對紅色毛癬菌進行抗菌的測試，和現行市面上藥物進行比對，測試兩者清除菌絲的效果，並透過將紅色毛癬菌感染豬皮後，分別用光動力療法和市售藥物兩種方式來進行處理，來觀察治療結束後，有無復發的情況發生。

Treatment of galactose -directing photodynamic therapy in *Trichophyton rubrum*
infection

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Abstract :

Taiwan's climate is subtropical climate, and it is warm and humid. This climate can easily form a breeding ground for various fungi. Fungi are mainly divided into two types: mold and yeast, and the most well-known athlete's foot in life is a disease that belongs to mold infection. Athlete's foot, officially called tinea pedis, is caused by infection of a fungus called *Trichophyton rubrum*. For tinea pedis, most patients with this condition have no subjective symptoms of discomfort, except for the epidermal scaling between the toes. Erosion, redness, swelling, itching and unpleasant odor may occur in some patients. In severe cases, it may cause onychomycosis, peeling of the nails, etc., and even break through the secondary infection of other subsequent bacteria, resulting in cellulitis, and in the most serious cases, there may be a risk of amputation.

For the treatment of *Trichophyton rubrum*, doctors usually use over-the-counter antifungal creams, which contain the main antibacterial ingredients, such as: Terbinafine (terbinafine, the main antibacterial ingredient of the Lamisil cream) and Clotrimazole (clotrimazole , the main antibacterial ingredient of Mycosten cream) to interfere with the synthesis of ergosterol in the cell membrane of the mold, causing the cells to gradually die. However, it is easy to relapse and cause trouble to people as long as the mycelium is not completely removed.

The purpose of this study is to use photodynamic therapy as an alternative treatment. The principle of photodynamic therapy is to select a photosensitizer and excite it with a specific wavelength of light to change it from the ground state to the excited state. In the process of releasing energy, when the oxygen and biomolecules

around the infected part absorb the energy, they will become singlet oxygen ($^1\text{O}_2$) and peroxide (ROS) respectively. Afterwards, fungi will be killed. In this study, we aim the adhesion of *Trichophyton rubrum* by galactose. Therefore, galactose is modified with chitosan, then ionically cross-linked with tripolyphosphate (TPP). At the process of cross-linking, lipophilic curcumin as a photosensitizer is added to be encapsulated. The antibacterial test of *Trichophyton rubrum* is carried out with blue light excitation and the results will be compared with the current drugs on the market, the removal effect of mycelium will be tested. Pig skin will be infected with *Trichophyton rubrum* and sequentially treated with photodynamic and commercially available drugs. The antibacterial efficiency and recurrence will be both tested.