嘉南藥理科技大學專題研究計畫成果報告

計畫編號：CNPH94-02 (2)

計畫名稱：具控釋效果之圓粒（pellet）型魚飼料研發

執行期間：94 年 1 月 1 日至 94 年 12 月 31 日

■整合型計畫　　□個別型計畫

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執行期間： 94 年 1 月 1 日至 94 年 12 月 31 日

執行單位：嘉南藥理科技大學 藥學系

中華民國 95 年 2 月 28 日

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具控釋效果之圓粒（pellet）型魚飼料研發
Investigation of Controlled Release Pellets for Fish Feeds
計畫編號：CNPH-94-02（2）
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一、中文摘要

理想的魚飼料應是能提供均衡的營養與良好的食料轉換效率卻不會影響水質。由於在水中與在魚腸道中酸鹼值的劇烈差異，本研究中我們嘗試發展酸鹼敏感性圓粒來控制魚飼料釋放。魚飼料購自市場並研磨成粉，魚飼料粉混合黏合劑經由擠出搓圓的過程而製成圓粒，該圓粒分別在 pH 7.0 與 pH 1.2 的條件下依美國藥典轉籃式溶離試驗法進行溶離試驗；結果顯示，魚飼料圓粒在中性環境下，可延緩釋離達 4 小時；圓粒在酸性的環境下，最初的一小時即經酸催化水解成小粒子並釋出包覆物質，上述結果有助於爾後發展其他魚飼料控制釋放系統之參考依據。

關鍵詞：控制釋放，酸鹼敏感性，圓粒，魚飼料

Abstract

Ideally, the fish feed that provide balanced nutrition and result in good feed conversion efficiency should not contaminate the water quality. Owing to drastic variation of pH value between in water and in fish gut, we attempt to develop a pH-sensitive pellet for controlled release of fish feed in this work. Original fish feed was bought from market and then grinded to powder. The pellets were obtained by combining the powder of feed and binders through extrusion-spheronization process. The release profiles of fish feed pellets were studied, using the USP rotating-basket dissolution method at pH 7.0 and pH 1.2. The results show that the release of pellets can be reduced for 4 hours in neutral medium. Moreover, the resulting pellets undergo acid-catalyzed hydrolysis into small parts and should therefore release encapsulated material (i.e. Vitamin B2) at an accelerated rate in acidic environments during first one hour. The above results will be helpful to possible development of the other fish feed controlled delivery systems.

Keywords: Controlled release, pH sensitive, Pellets, Fish feeds

二、Introduction

30% of the world's seafood is supplied by the aquaculture industry. Fish farming is a rapidly growing industry.(1) For the past 20 years, this has been the fastest growing segment of aquaculture. Asian countries lead the world in aquaculture production with 70% of the world's fish feed being consumed in this region. (2,3) Fish farmers actively seek to exploit certain aspects of feeding behaviour to optimize and hopefully therefore to maximize their production. Two aspects are of prime interest, namely increasing appetite and therefore consumption of food and ensuring that dietary energy is maximized for growth and minimized for general daily expenditure (swimming, feeding). (4,5) Thus, fish growers maximize their productivity by using feeds that provide balanced nutrition and result in good feed conversion efficiency. Proper nutrition is an essential component to increased weight gain and overall fish health. An alternative aspect through the production cycle has on occasion come to the fore in recent years in Taiwan is well health management. (6-8) Successful fish health management begins with prevention of disease rather than treatment. Prevention of fish disease is accomplished through good water quality management, nutrition, and sanitation. In regard to water quality management and nutrition, the good feed should not contaminate the water quality. (9) It is well known that hydrochloric acid is secreted to reduce gut pH and to allow enzymes to work in fish with a stomach. The level of pH value before and after digestion is a key indicator of disintegration of feed. The pH-sensitive controlled release of feed to maximum food consumption is a minimization of waste food, leaching and overall pollution. In the present study, we attempt to investigate controlled release pellets of fish feed in intensive culture as following: cost-effectiveness of feed (i.e. the cheapest feed that can adequately supply nutrient requirement), attractiveness to the fish, efficiency of the feed conversion ratio, and stability in water to prevent feed loss and minimize water pollution.

三、Results and discussion

The extrusion-spheronization is one of the valuable methods used to prepare pellets. The formulations used in the experiments are shown in Table 1. Vitamin B2 was added as a marker for dissolution tests. The binary mixtures of vitamin B2 and fish feeds as bulk materials were dry mixed thoroughly. After the water or Eudragit gel was added as a binding agent, the moistened mass was immediately passed through a

20 mesh sieve. The resulting extrude was then sphered by rotating friction plate. The produced pellets were dried at room temperature. The release of vitamin B2 from the prepared pellets was determined over 24 hours, using the USP rotating-basket dissolution method at 150 rpm, 1000 ml of HCl 10 solution (pH=1.2) and PBS solution (pH=7.0) at 37℃±0.5 ℃ were used as a dissolution medium. After dissolution test, the residual pellets in rotating-basket were collected and dried in the oven to achieve a " constant weight". The percentage of disintegration in pellet is then calculated.

Table 1. Formulae of fish feed pellet product

Composition	Amount ratio （%,W/W）
Feed dried powder	72.2~98.7
Vit.B2	0~1.0
Eudragit EP100	0~1.3
Acetic acid	0~0.5
Water	0~25
Total	100

The spherical pellets were obtained by extrusion-spheronization process. The particles have a mean particle size ranging from 500 μ m to 1000 μm is shown in Fig. 1.

The original fish feed which was bought from market disintegrated significantly at pH 7.0 than at pH1.2 (Fig 2). While the feed were grinded to powder and then prepared to form pellet with water as a binder. The release profile of pellet is similar to original fish feeds and shown in Fig 3, the more vitamin B2 diffused out from the pellets resulting in an increase in pH value. The character of fish feed will result early broken down into smaller parts in water but hardly converted to absorbed nutrients from food in fish gut. This is a source of water pollution through aquaculture. Instead of water, Eudragit EP100 was used as a binder that suitably exploits both pH-sensitive and time-dependent functions. It can be seen that the release of pellets can be reduced for 4 hours in neutral medium. Moreover, the resulting pellets undergo acid-catalyzed

hydrolysis into small parts and should therefore release encapsulated material (i.e. Vitamin B2) at an accelerated rate in acidic environments during first one hour as shown in Fig 4.

ACKNOWLEDGMENT
This project was supported by the Chia Nan University of Pharmacy and Science.

Fig. 1. The photograph of fish feed pellets obtained by extrusion-spheronization process. 0.30.40.50.60.70.80.9102468101214161820224PH1.2PH7.0 以水為 binder 含 B2

Fig. 2. Release profile of vitamin B2 from original fish feeds in pH1.2 and pH7.0 solution.

0.10.150.20.250.30.350.40.450.5024681012141618202224
時間(hrs)
吸光?
pH=1.2pH=7.0

Fig. 3. Release profile of vitamin B2 from pellet with water as a binder in pH1.2 and pH7.0 solution.

0.10.150.20.250.30.3502468101214161820224
時間(hrs)
吸光?
pH=1.2pH=7.0
Fig. 4. Release profile of vitamin B2 from pellet with Eudragit EP100 as a binder in pH1.2 and pH7.0 solution.

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