Optimization of fermentation process for Nomuraea rileyi

薛一祥、謝建元

E-mail: 9019815@mail.dyu.edu.tw

ABSTRACT

The purpose of this research was studying the optima production of mycelia and conidia spore of Nomuraea rileyi by using the response surface method in submerged cultural fermentation and solid-stat fermentation, respectively. In submerged cultural fermentation, the glucose was found to be the best carbon source for the growth of mycelia among glucose, fructose, sucrose, maltose, and molasses. On the other hand, the corn steep powder was the better nitrogen in the selected testing nitrogen source such as yeast extract, peptone, and corn steep powder. The V8 juice as the additive was found the promoting mycelia growth effect in the media with glucose and corn steep powder. Other physical conditions in the shake flask study, the pH6 as initial growth pH and higher shaker rotation speed were also found favor the mycelia growth. The optima growth compositions from the RSM was 3.2% glucose, 29% V8 juice, and 15% corn steep powder resulted 12.1 g-cell dry weight per liter. This result was applied to scale up in the 5-L fermentor. The higher agitation speed of the fermentor has higher cell production and has lower oxygen contain in the output gas with 1 vvm aeration. However, at higher aeration of 2 vvm the speed of mixing was not affected significant at 250 rpm, 350 rpm, and 450 rpm. Finally, the best cell production was found as high as 16.4 g-cell dry weight per liter. In solid-stat fermentation, the RSM was also applied in the optima spore production. The molasses, corn steep powder, yeast powder, fishmeal, and sorghum were found to be the best medium for the growth and conidia spore production with 4.76×109 conidia/g-dry weight. The scale up study of solid-stat fermentation was carrying out from the plate, plastic bag, and all the way to 22-L bioreactor. In 22-L bioreactor the higher spore production 6.8×109 conidia/g-dry weight was found at light intensity 2800-Lumens/m2 and light period of L/D=12/12. Against 4-th star larva of Spodoptera exigua the conidia spore from the bioreactor has 56.05±5.43% mortality. This result was closes to the conidia spore from the SMAY slant.

Keywords : Nomuraea rileyi ; solid-stat fermentation ; submerged cultural fermentation ; conidia ; mycelia

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REFERENCES

參考文獻 吳幸娟。1990。以固定化酵母釀造米酒之試驗。文化大學家政所碩士論文。 吳美貌。1993。蘇力菌素的發酵產製、分離純化與生物檢定。大葉大學食品工程研究所碩士論文。 林意欣。1997。以米酒槽液產製酸性蛋白質分解酵素之試驗。東海 大學化學工程研究所碩士論文。 唐立正。1997。本地產綠殭菌感染玉米穗夜蛾之研究。國立中興大學昆蟲學系博士論文。 高穗生、蔡勇勝。1995。蟲生病原真菌在蟲害防治上之利用。藥試所專題報導 38、39:16-18。 黃賜源。1996。靈芝液態培養及氣舉式生物反應器應用之實驗。東海大學化學工程研究所碩士論文。 楊世民、林讚峰。1994。簡介利用回應曲面實驗設計法決定工業微生物的最佳培養基。製酒科技專論彙編 16:135-150。 蔡淑珍。1988。蟲生真菌之調查及綠殭菌感染斜紋夜盜之生理學與病理學。國立台灣大學植物病蟲害學研究所碩士論文。 蕭文鳳、莊凱順、鄭峰銘。1997。溫溼度和十字花科植物與白殭菌對偽菜蚜毒力之影響。嘉義農專學報52:101-108。 謝建元、洪文凱、高穗生、王順成、曾耀銘。1998。本土黑殭菌以固態和液態發酵生產黑殭菌素之探討。中國農業化學會誌36（4）:371-379。
Boucia, D. G. and Pendland, J. C. 1984. Nutritional requirements for conidial germination of several host range pathotypes of the entomopathogenic fungus, Nomuraea rileyi. J. Invertebr. Pathol. 43: 288-292. Cherry, A. J., Jenkins, N E., Heviefo, G., Batemen, R. and Lomer, C. J. 1999. Operational and economic analysis of a West African pilotscale production plant for aerial conidia of Metarhizium spp. for use as a mycoinsecticide against locust and grasshoppers. Biocontrol Science and Technology. 9: 35-51. Cliguet, S. and Scheffer, R. J. 1997. Influence of culture conditions on growth and survival of conidia of Trichoderma spp. coated on seeds. Biocontrol Science and Technology. 7: 171-181. Gardner, W. A., Sutton, R. M. and Noblet, R. 1977. Persistence of Beaveria bassiana, Nomuraea rileyi and Nosema necatrix on soybean foliage. Environ. Entomol. 6: 616-618. Garicia, C. and Ignoffo, C. M. 1977. Dislodgment of Nomuraea rileyi from cadavers of cabbage looper, Trichoplusia ni. J. Invertebr. Pathol. 30: 114-116. Getzin, L. W. 1961. Spicaria rileyi（Farlow）Charles ,an entomopathogenous fungus of Trichoplusia ni（Huebner）. J. Insect Pathol. 50: 67-69. Glare, T. R.（1987）Effect of host species and light conditions on production of conidia by an isolate of Nomuraea rileyi. J. Invertebr. Pathol. 50: 67-69. Holdom, D. G. and Van de Klashorst, G. 1986. Inexpensive culture media and methods for Nomuraea rileyi. J. Invertebr. Pathol. 48: 246-248. Horton, D. L, Carner, G. R. and Turnipseed, S. G. 1980. Pesticide inhibition of the entomgenous fungus Nomuraea rileyi in soybean. Environ. Entomol. 9: 304-308. Ignoffo, C. M. 1981. The fungus Nomuraea rileyi as a microbial insecticide. In 〃Microbial Control of Pest and Plant Diseases 1970-1980.〃（H. D. Burges , ed.) , Academic Press, New York. pp. 513-537. Ignoffo, C. M. and Garcia, C. 1985b. Host spectrum and relative virulence of an Ecuadoran and a Mississippian biotype of Nomuraea rileyi. J. Invertebr. Pathol. 45: 346-352. Ignoffo, C. M., Garcia, C. 1978. In vitro inactivation conidia of the entomopathogenic fungus Nomuraea rileyi by human gastric juice. Environ. Entomol. 7: 217-218. Ignoffo, C. M., Garcia, C. and Gardner, W. A. 1985a. Temperature stability of wet and dry conidia of Nomuraea rileyi（Farlow）Samson. Environ. Entomol. 14: 87-91. Ignoffo, C. M., Garcia, C. and Hostetter, D. L. 1976. Effects of temperature on growth and sporulation for the entomopathogenic fungus Nomuraea rileyi. Environ. Entomol. 5: 935-936. Ignoffo, C. M., Garcia, C. and Hostetter, D. L. and Pienll, R. E. 1977. Vertical movement of conidia of Nomuraea rileyi through sand and loam soil. J. Econ. Entomol. 70: 163-164. Ignoffo, C. M., Garcia, C. and Kroha, M. J. 1982a. Susceptibility of larvae of Trichoplusia ni and Anticarsia gemmatalis to intrahemocoelic injections of conidia and blastospores of Nomuraea rileyi. J. Invertebr. Pathol. 39: 198-202. Ignoffo, C. M., Garcia, C. Kapp, R. W. and Coate, W. B. 1979. An evaluation of the risk to mammals of the use of an entomopathogenic fungus, Nomuraea rileyi, as a microbial insecticide. Environ. Entomol. 3: 354-358. Ignoffo, C. M., Hostetter, D. L. Garcia, C. and Pienll, R. E. 1975. Sensitivity of the entomopathogenic fungus Nomuraea rileyi to chemical pesticides used on soybeans. Environ. Entomol. 4: 765-768. Ignoffo, C. M., McIntosh, A. H., Garcia, C., Kroha, M. J. and Johnson, J. M. 1982b. Effect of successive in vitro and in vivo passages of the virulence of the entomopathogenic fungus,

Nomuraea rileyi. Entomophaga. 27: 371-378. Ignoffo, C. M., Puttler, B., Hostetter, D. L. and Dickerson, W. A. 1976. Susceptibility of the cabbage looper, Trichoplusia ni and the velvetbean caterpillar, Anticarsia gemmatalis, to several isolates of the entomopathogenic fungus Nomuraea rileyi. J. Invertebr. Pathol. 28: 259-262. Kish, L. P., Samon, R. A. and Allen, G. E. 1974. The genus Nomuraea Maublanc. J. Intvertebr. Pathol. 24: 154-158. Tang, L. C. and Hou, R. F. 1998. Potential application of the entomopathogenic fungus, Nomuraea rileyi, for control of the corn worm, Helicoverpa armigera. Entomol. Exp. Appl. 88: 25-30. Liu, B. L. and Tzeng, Y. M. 1999. Water content and water activity for the production of cyclodepsipeptides in solid-state fermentation by Metarhizium anisopliae. Biotechnol. Lett. 21: 657-661. Lonsane, B. K., Saucedo, C. G., Rainbault, M., Roussos, S., Viniegera, G. G., Ghildyal, N. P. and Ramakrishna, M. M. 1992. Scale-up strategies for solid state fermentation system (review). Process Biochem. 27: 259-273. Maurice, R. and Didier, A. 1980. Culture method to study fungal growth in solid fermentation. J. Appl. Microbiol. Biotechnol. 9: 199-209. Mohamed, A. K. A., Sikorowski, P. P. and Bell, J. V. 1977. Susceptibility of Heliothis zea larvae to Nomuraea rileyi at various temperature. J. Invertebr. Pathol. 30: 414-417. Ooijkaas, L. P., Tramper, J. and Buitelaar, R. M. 1998. Biomass estimation of Coniothyrium minitans in solid-state fermentation. Enzyme Microbiol. Technol. 22: 480-486. Ramesh, M. V. and Lonsane, B. K. 1990. Critical importance of moisture content of the medium in alpha-amylase production by Bacillus licheniformis M27 in a solid state system. Appl. Microbiol. Biotechnol. 33: 501-501. Roukas, T. and Maria, L. K. 1999. Production of pullulan from beet molasses by Aureobasidium pullulans in a stirred tank fermentor. J. Food Eng. 40: 89-94. Stuart, D. M., Mitchell, D. A., John, M. R., and Lister, J. D. 1999. Solid-State Fermentation in Rotating Drum Bioreactors : operating variables affect performance through their effects on transport phenomena. Biotechnol. Bioeng. 63: 383-391. Sun, T. L., Beihui, L. P., Liu, D. and Li, Z. 1998. New solid-state fermentation process for repeated batch production of fibrinolytic enzyme by Fusarium oxysporum. Process Biochem. 33: 419-422. Throvilson, H. G. and Pedigo, L. P. 1984. Epidemiology of Nomuraea rileyi（Fungi: Deuteromcotina ） in Plathypena scabra（Lepidoptera: Noctuidae）populations from Iowa soybeans. Environ. Entomol. 13: 1491-1497. Throvilson, H. G. and Pedigo, L. P. and Lewis, L. C. 1985. Soybean leaf consumption by Nomuraea rileyi （Fungi: Deuteromcotina） infected Plathypena scabra （Lepidoptera: Noctuidae） larvae .J. Invertebr. Pathol. 46: 265-271. Vimala Deri, P. S. 1994. Conidia production of the entomopathogenic fungus Nomuraea rileyi and its evaluation for control of Spodoptera litura（Fab）on Ricinus communis. J. Invertebr. Pathol. 63: 145-150. Yang, Z., Wieger, K., Jan, P. S. and Jan, B. 1996. Medium Optimization for nuclease P1 production by Penicillium citrinum in solid-state fermentation using polyurethane foam as inert carries. Enzyme Microbiol. Technol. 18: 108-112.