Talaromyces species: DIVERSITY, TAXONOMY, PHYLOGENY, ANTAGONISTIC ACTIVITY AGAINST PLANT PATHOGENIC FUNGI AND SECONDARY METABOLITES

INTRODUCTION

Talaromyces is an ascomycete was erected by Benjamin in 1955 with *T. vermiculatus* as a type species. It belongs to the Class Ascomycetes, Order Eurotiales, Family Trichocomaceae Fischer (syn. Eurotiaceae Clem. & Shear) (Kirk *et al.*, 2001). Five different genera of anamorphic state were reported including *Penicillium*, *Paecilomyces, Geosmithia, Merimbla* and *Sagenomella*. Most anamorphic state was however, belonged to *Penicillium*, section Biverticillate– Symmetrica (Stolk and Samson, 1972; Pitt, 1979a; Heredia *et al.*, 2001). *Talaromyces* produces ascomata, white, yellow to red, soft, globose to subglobose, superficial, discrete or confluent. Ascomatal coverings consisting of a network of hyphae, usually surrounded by a weft of thin hypha, straight or twisted depending on the species. Asci evanescent, mostly 8 ascospores, globose to subglobose or slightly ellipsoidal, borned in chains. Ascospores globose or ellipsoidal, smooth or showing various ornamentations (Stolk and Samson, 1972; Pitt, 1979a).

Forty six species and 6 varieties of *Talaromyces* were recorded from soil, debris, manure, agricultural and industrial wastes, dungs and foods, with a worldwide distribution (Domsch *et al.*, 1993a, b; Pitt, 1979a; Pitt *et al.*, 2000; Samson, 2000; Stolk and Samson, 1972. In Thailand, 9 species and 2 varieties of *Talaromyces* were reported including *Talaromyces vermiculatus* (syn. *T. flavus*), *T. flavus* var. *flavus, T. flavus* var. *macrosporus*, *T. spiculisporus* (syn. *T. trachyspermus*), *T. striatus, T. byssochlamydoides*, *T. emersonii*, *T. trachyspermus*, *T. wortmannii*, *T. bacillisporus* and *T. rotundus*. They were isolated from forest, agricultural, mangrove soil, soil at termite mounds, dungs and decomposing starters (Chana, 1974; Cruesrisawath, 1985; Kanjanamaneesathian, 1988; Manoch, 2004; Manoch *et al.*, 2004, 2005; Sudpro, 1999; Wongthong, 2001; Busarakum, 2002; Ito *et al.*, 2001; Jeamjitt, 2007).

The evolutionary relationships of *Talaromyces* species are very interesting because the morphology of both teleomorphs and anamorphs of these fungi indicate a close relationship to other genera of the Trichocomaceae (Taylor *et al.*, 1990; LoBuglio *et al.*, 1993; Wang and Zhuang, 2007). Taylor *et al.*, (1990) and Luangsa-ard *et al.*, (2004) reported *Talaromyces* species (*Paecilomyces* anamorph) cluster with *Byssochlamys* and *Thermoascus* species having *Paecilomyces* anamorph, not with *Talaromyces* species having *Penicillium* anamorphs. Yaguchi *et al.*, (2005) were able to demonstrate, using D1/D2 region of 28S rDNA sequence analysis, that *Geosmithia argillacea* is the anamorph of *Talaromyces eburneus*. Heredia *et al.*, (2001) described a new species, *Talaromyces ocotl* with *Sagenomella* sp. anamorph, based on morphological analyses and phylogenetic inferences made from ITS and 28S rDNA sequence alignments.

Talaromyces flavus is the most common species and has been reported as an effective biological control agent against several plant pathogenic fungi including *Verticillium dahliae*, *Sclerotinia sclerotiorum* and *Sclerotium rolfsii*, the causal of verticillium wilt of eggplant, white mold of dry bean and bean stem rot respectively (Fahima and Henis, 1995; Fravel, 1996; Huang *et al.*, 2000; Madi *et al.*, 1997; McLaren *et al.*, 1986). The mechanisms for biological control activity involved mycoparasitism (Fahima *et al.*, 1992; Madi *et al.*, 1997), antibiosis (Kim *et al.*, 1990a, b; Stosz *et al.*, 1996) and competition (Marois *et al.*, 1982).

Several species of *Talaromyces* can produce bioactive compounds, such as talaroderxines A and B from *T. derxii* having activity against *Bacillus subtilis* (Suzuki *et al.*,1992), *T. trachyspermus* SANK 12191 produces trachyspic acid which inhibit tumor cell heparanase (Shiozawa *et al.*, 1995) and *T convolutus* isolated from barley in Japan can produce talaroconvolutins which inhibit plant and human pathogenic fungi including *Aspergillus fumigatus*, *A. niger, Candida albicans* and *Cryptococcus neoformans* (Suzuki *et al.*, 2000). Several new compounds were reported from other species of *Talaromyces*, such as wortmanilactones A-D from *T. wortmannii* (Dong *et al.*, 2006), and three new azaphilones, luteusins A-E from *T. luteus* (Yoshida *et al.*, 1996).

It is very interesting to study the genus *Talaromyces* on various topics in Thailand, especially diversity, taxonomy, phylogeny, antagonistic test against plant pathogenic fungi and the produced secondary metabolites. Because this fungus was poorly known with the only important reports contributed by Manoch *et al.* (2004) and Luangsa-ard *et al.* (2004). Their studies were limited in taxonomy and phylogeny. Therefore, more investigations on *Talaromyces* species need to be carried out in this tropical region for the discovery of new taxa, the utilization of some species as biological control agents against plant pathogenic fungi and the analysis for secondary metabolites on several species of this genus is a very challenging topic for industrial, phamaceutical and agricultural enterprises.

OBJECTIVES

1. To isolate *Talaromyces* spp. from soil from different locations in Thailand

2. To study morphological characteristics of *Talaromyces* species

3. To determine diversity and distribution of *Talaromyces* species from various soil samples

4. To maintain the pure cultures of *Talaromyces* species in a culture collection

5. To study molecular phylogeny of the isolated *Talaromyces* species

6. To study antagonistic activity tests of *Talaromyces* against 15 species of plant pathogenic fungi *in vitro* and in the greenhouse

7. To investigate the secondary metabolites of the two species of *Talaromyces*; *T. bacillisporus* and *Talaromyces* sp. 1 (KUFC 3399)