

INFLUENCE OF ADJUVANTS ON SHELF LIFE OF *Pichia guilliermondii* IN POWDER CARRIERS AND THEIR EFFICACY CONTROL BLUE MOLD OF APPLE *

L. MOKHTARNEJAD^{1**}, H. R. ETEBARIAN¹, M. R. FAZELI²
and M. R. KHOSHAYAND²

(Received: 2. 1. 2011; Accepted: 7. 9. 2011)

Abstract

In this study the efficacy of sucrose, sodium alginate and Gum arabic as adjuvants on yeast cells (*Pichia guilliermondii*) viability in powder formulations was determined. Yeasts, grown on a sugarcane molasses-based medium, were combined with talc, kaolin, wheat bran or rice bran carriers and three adjuvants (sucrose, sodium alginate, Gum arabic) and the viability of yeast in 16 formulations was determined over a six month periods. Formulation no. 11, containing wheat bran with sucrose, and formulation no. 15, containing wheat bran with sucrose had significantly higher viable yeast cells content over a six months storage period in 4. Formulation no. 2, containing kaolin had a significantly lowest viable yeast cell. In 24°C, formulation no. 15 had significantly highest viable yeast cells and formulation no. 2 had significantly lowest viable yeast cells content over a six months storage period. These formulations were tested against *Penicillium expansum* apple, the blue mold pathogen and all formulations effectively controlled the disease. Formulation no. 15, containing wheat bran and sucrose were the best formulation in controlling blue mold of apple.

Keywords: Formulation, *Penicillium expansum*, Carriers, Biological control.

See Persian text for figures and tables (Pages ۴۳۵-۴۴۶).

*: A Part of MSc. Thesis of the First Author, Submitted to College of Aburaihan, University of Tehran, Tehran, Iran.

***: Corresponding Author, Email: Imokhtarnejad@yahoo.com

1. Former MSc. Student and Prof. of Plant Pathology, College of Agriculture, Respectively, College of Aburaihan, University of Tehran, Tehran, Iran.

2. Assoc. Prof. and Assis. Prof. of Drug. and Food Department, College of Pharmacy, University of Medical Science, Tehran, Iran.

References

- ABADIAS, M., TEIXIDO, N., USALL, J., VINAS, I. and MAGAN, N. 2000. Solute stresses affect growth patterns, endogenous water potentials and accumulation of sugars and sugar alcohols in cells of the biocontrol yeast *Candida sake*. **J. Appl. Microbiol.** 89: 1009-1017.
- ABADIAS, M., USALL, J., TEIXIDO, N. and VINAS, I. 2003. Liquid formulation of the postharvest biocontrol agent *Candida sake* CPA-1 in isotonic solutions. **Phytopathol.** 93: 436- 442.
- ARRAS, G. and ARRUE, S. 1999. Integrated control of postharvest citrus decay and induction of phytoalexins by *Debaryomyces hansenii*. **Adv. Hort. Sci.** 13: 76-81.
- BORA, T., OZAKTAN, H., GORE, E. and ASLAN, E. 2004. Biological control of *Fusarium oxysporum* f. sp. *melonis* by wettable powder formulations of the two strains of *Pseudomonas putida*. **J. Phytopathol.** 152: 471-475.
- CAESAR, A. J. and BURR, T. J. 1991. Effect of conditioning, betaine, and sucrose on survival of rhizobacteria in powder formulations. **Appl. Environ. Microbiol.** 57: 168-172.
- CHRISTOPH, R., N. SHRINIVASA and B. STEPHANE. 2004. Determination of water content in powdered milk. **Food Chem.** 86: 457-464.
- CONNICK JR., W.J., DAIGLE, D.J., PEPPERMAN, A.B., HEBBAR, K.P., LUMSDEN, R.D., ANDERSON, T.W. and SANDS, D.C. 1998. Preparation of stable, granular formulations containing *Fusarium oxysporum* pathogenic to narcotic plants. **Biol. Control.** 13: 79-84.
- CONNICK W. R. 1988. Formulation of living biological control agents with alginate. ACS-Symposium, 371:241-250.
- DROBY, S. 2004. **Non-chemical treatments in postharvest.** Lecture notes. International Research and Development Course on Postharvest Biol. Technol., The Volcani Center, Israel (cited by Irtwange, 2006).
- DRUVEFORS, U.A. 2004. **Yeast biocontrol of grain spoilage moulds—mode of action of *Pichia anomala*.** PhD. Thesis Submitted to Swedish University of Agricultural Sciences, 44pp.
- GHOLAMNEJAD, J. 2009. Studies on biological control of blue mold in apple by some yeast isolates and their mechanisms of antagonism. MSc. Thesis Submitted to University of Tehran. 152PP. (In Farsi)
- GHOLAMNEJAD, J. ETEBARIAN, H. R SAHEBANI N. and ROUSTAEI A. 2009. Characterization of biocontrol activity of two strain from Iran against blue mold apple in order to reduce the environmental pollution. **J. Inter. Environ. App. & Sci.** 4: 28-36
- HOFSTEIN, R., FRIEDLENDER, B., CHALUTZ, E. DROBY, S. 1994. Large scale production and pilot testing of biocontrol agents of postharvest diseases. Pp. 89-100. In: Wilson, C.L., Wisniewski, M. (Eds.), **Biological Control of Postharvest Diseases—Theory and Practice.** CRC Press, Boca Raton, FL, USA,
- JANISIEWICZ, W.J. and JEFFERS, S.N. 1997. Efficacy of commercial formulation of two biofungicides for control of blue mold and gray mold of apples in cold storage. **Crop Protect.** 16: 629-633.
- KINAY, P. YILDIZ, M. 2008. The shelf life and effectiveness of granular formulations of *Metschnikowia pulcherrima* and *Pichia guilliermondii* yeast isolates that control postharvest decay of citrus fruit. **Biol. Control.** 45:433-440.
- MC CABE, D. and SOPER, R.S. 1985. **Preparation of an entomopathogenic fungal insect control agent.** U.S. patent No. 4,530,834.
- MELIN, P., HAKANSSON, S., EBERHAD, TH and SCHNURER, S. 2006. Survival of the biocontrol yeast *Pichia anomala* after long-term storage in liquid formulations and different temperatures, assessed by flow cytometry. **J. Appl. Microbiol.** 100:264-271.
- MELIN, P., HAKANSSON, S. and SCHNURER, S. 2007. Optimisation and comparison of liquid and dry formulations of the biocontrol yeast *Pichia anomala* J121. **J. Appl. Microbiol. Biotechnol.** 73:1008-116.
- SHABANA, Y.M. SAUERBORN, J. 2003. Granular pest formulation of *Fusarium oxysporum* f. sp. *Orthoceras* for biological control of sunflower broomrape: efficacy and shelf-life. **Biol. Control.** 26 (2): 189-201.

- MOKHTARNEJAD, L., ETEBARIAN, H. R. and FAZELI, M. R. 2010. Survival of *Pichia guilliermondii* yeast isolate in powder formulation and examination of formulations potential for biological control of blue mold of apple. **Iran. J. Plant Protect.** 41(1): 9-18. (In Farsi With English Summary)
- MULLER-STOVER, D., THOMAS, H., SAUERBORN, J. and KROSCHEL, J. 2004. Two granular formulation of *Fusarium oxysporum* f. sp. *Orthoceras* to mitigate sunflower broomrape *Orbanche cumana*. **Biocontrol.** 49: 595-602.
- SPADARO, D. and GULLINO, M.L. 2004. State of the art and future prospects of the biological control of postharvest fruit diseases. **Inter. J. Food Microbiol.** 91(2): 185-194.
- USALL, J., TEXIDO, N., FONS, E. and VINAS, I. 2000. Biological control of blue mould on apple by a strain of *Candida sake* under several controlled atmosphere conditions. **Food Microbiol.** 58: 83-92.
- VERO, S., MONDINO, P., BURGAENO, J. SOUBES, M. and WISNIEWSKI, M. 2002. Characterization of biological activity of two yeast strains from Uruguay against blue mold of apple. **Postharvest Biol. Technol.** 26: 91-98.
- WILSON, C.L. and WISNIEWSKI, M.E. 1994. **Biological control of postharvest diseases – Theory and Practic.** CRC Press, Boca Raton, Florida, 182pp.
- WILSON, C.L. and WISNIEWSKI, M.E. 1989. Biological control of postharvest diseases of fruits and vegetables an emerging technology. **Annu. Rev. Phytopathol.** 27: 425-441.
- ZIDACK, N.K. and QUIMBY, P.C. 1999. Formulation and application of plant pathogens for biological weed control. Pp. 371–379 *In*: Hall, F.R. and Menn, J.J. (Eds.), **Methods in Biotechnology**, vol. 5: **Biopesticides: Use and Delivery.** Humana Press, Totowa, NJ.