

CO-PRODUCTION OF LACTIC ACID AND CHITIN USING A PELLETIZED
FILAMENTOUS *RHIZOPUS ORYZAE* CULTURE FROM CULL POTATOES

Abstract

by Yan Liu, Ph.D.
Washington State University
December 2005

Chair: Dr. Shulin Chen

This dissertation research explored feasibility of co-production of lactic acid and chitin from cull potatoes. Cull potatoes are underutilized agricultural products that provide only minimal financial return to the growers. However, fresh cull potato, with its rich composition in starch and nutrients, can be an ideal raw material for lactic acid production. Lactic acid is currently widely employed as an acidulant, flavoring, and preservative in the food industry. It can also be used to synthesize polylactic acid, a feedstock chemical for biodegradable plastics. A considerable amount of fungal biomass can be concurrently produced during the synthesis of lactic acid using some fungal strain. Chitin, the primary composition of the fungal cellular wall, can be extracted from the fungal biomass. Chitin and its derivatives are useful products that are utilized in wastewater treatments, cosmetics manufacturing and biomedical applications. The biomedical applications, in particular, are of great consequences as chitin has been proven to be constructive in promoting tissue growth, accelerating wound-healing and regenerating bone.

Rhizopus oryzae, a filamentous fungus used in this study, usually develops a cotton-like morphology that is associated with low yield and inadequate productivity of

lactic acid. This is uneconomical for commercial fermentation purposes. Growing fungi in pellet form can circumvent these problems.

The overall goal of this study was to develop an innovative process for lactic acid and chitin co-production using pelletized *Rhizopus oryzae* NRRL 395 to improve both fermentation yield and productivity with cull potatoes as nutrient source. The specific objectives were to; (1) refine the pellet formation process to produce desired size and number of pellet nuclei, (2) develop a mathematical model that describes the pellet formation as a function of culturing factors, and (3) optimize the pellet growth, lactic acid and chitin production by controlling operational parameters.

The major results obtained from this research were: (1) biodegradable polymer additive and spore storage time were determined to be the important factors in pellet formation. Multiple logistic regression models provided good pellet formation prediction, (2) high biomass and chitin yield were obtained by culture fungus on potato hydrolysate, (3) pelletized morphology significantly improved the lactic acid production in terms of productivity, yield, and lactate concentration in the broth, and (4) enhanced co-production of lactic acid and chitin were achieved by repeated-batch and fed-batch with mixed alkaline to adjust pH using cull potato and glucose as raw materials.