

## PRODUCTION OF CORN OIL IN DRY GRIND ETHANOL PLANTS

Jason Kwiatkowski<sup>1</sup> and Munir Cheryan<sup>2\*</sup>

Agricultural Engineering and Food Science and Human Nutrition,  
University of Illinois at Urbana-Champaign, Urbana, IL 61801 (217-333-9332)

The dry grind process for ethanol is used widely because of its simplicity, low capital cost and high yield of ethanol. However, many of these plants would be unable to survive without government subsidies and tax waivers. To improve their economic viability, dry grind ethanol plants should produce additional higher value coproducts preferably without seriously altering the current process or lowering the value of their current products. Corn oil now passes through the dry grind process into the coproduct stream, which is sold at low margins. If corn oil could be extracted using in house milled corn and ethanol, it would add significant revenue without any additional materials coming in to the plant.

There have been attempts in the past to develop such processes. Chien et al (1) and Hojilla-Evangelista et al (2) first dried corn to a low moisture content. The ethanol from fermentation of corn starch was used for protein extraction and to simultaneously extract corn oil and dehydrate the ethanol. In the "quick germ" process (3), the germ is recovered after whole corn is soaked in water for 3 to 12 hr and processed similar to wet milling degermination.

Our objective was to optimize oil extraction from whole ground corn using ethanol as it would be practiced in a typical dry grind ethanol plant. No additional treatment was given to the corn, such as tempering, steeping or drying prior to use. Variables studied were time of extraction, concentration of ethanol in the extractant (i.e., moisture content of the ethanol), temperature of extraction and ratio of solvent to solids. Optimum conditions were a solvent to solids ratio of 4 ml/g corn, an ethanol concentration of 100%, 30 min of extraction time and a temperature of 50 C. Under these conditions, a single batch extraction yields ~3.3 g oil/100 g corn, equivalent to an extraction efficiency of 70%. A 3 stage extraction, where the same corn is exposed to fresh ethanol, results in a yield of ~4.5 g/100 g corn, equivalent to an oil yield of 93% and 2.5 lb/bu of corn. When the same ethanol was used to extract fresh corn, it resulted in a linear uptake of moisture by ethanol from the corn in successive stages. This resulted in a decrease in oil yield and an increase in nonoil components being extracted.

1. Chien, J.T., J.E. Hoff, M.J. Lee, H.M. Lin, Y.J. Chen and L.F. Chen. 1990. Oil Extraction of dried ground corn with ethanol. *Chem. Eng. J.* 43:B103-B113.
2. Hojilla-Evangelista, M.P., D.J. Myers and L.A. Johnson. 1992. Characterization of protein extracted from flaked, defatted, whole corn, by the sequential extraction process. *J. Am. Oil Chem. Soc.* 69:199-204.
3. Singh, V. and S.R. Eckhoff. 1997. Economics of germ preseparation for dry grind ethanol facilities. *Cereal Chem.* 74:462-466.