MARKET DEMAND

# Exploring Market Diversification: Value-Added Fermentations of Peas

Manitoban peas, in the form of pea meal, pea flour or purified pea protein may be used as a nitrogen source for industrial lactic acid, ethanol and antibiotic fermentations.

**ENERGY, FUEL, PLASTICS,** chemicals and medicines have the potential to be derived from plant biomass rather than fossil fuels. Already, starch sourced from corn and wheat are used to produce ethanol for fuels while soybeans, canola and corn provide oil for biodiesel production.

Industrial fermentations produce fuel ethanol, pharmaceuticals and lactic acid. The latter is used as a green solvent, food acidulant and as a raw material for biodegradable plastic. New fermentation processes are being developed to produce solvents, fuels, plastics and chemical industry feedstocks. For these fermentations to occur, a source of nitrogen (N) is required. Given their high protein content, peas should be an excellent source of N for fermentation microorganisms.

This project investigated the use of pea flour and purified pea protein as an inexpensive N source in three typical commercial fermentations, including antibiotic production, lactic acid production (polylactide plastics) and as a fermentation-promoting ingredient in fuel and beverage ethanol fermentations. These fermentations are either high-volume or produce high-value products and would provide a valuable new market for Manitoba pulses.

## LACTIC ACID

Pea flour and purified pea protein supported the growth of lactic acid bacteria (LAB). Rates and concentrations of lactic acid produced by these bacteria were comparable to the expensive conventional media. In addition, LAB are used in the food processing industry as inoculants in cheese, yogurt, sauerkraut, pickles and ready to eat meats, such as salami. Pea protein could provide a competitive source of nitrogen for these relatively high-value fermentation products. This fermentation would also seem to be the most likely opportunity to incorporate peas as a media ingredient.

## ETHANOL

Growth and production of ethanol by *Saccharomyces cerevisiae* (brewer's yeast) was successful using pea flour and purified pea protein. The use of this high-protein fermentation media resulted in increased rates of fermentation and increased the absolute concentration of ethanol.

For lower-value products, such as fuel ethanol, where the raw material (typically wheat or corn) provides sufficient nitrogenous nutrients, it is unlikely to be cost effective to add pea protein. However, the ability of pea protein to overcome yeast inhibition at high substrate concentrations may make it economical for fuel ethanol producers to add pea protein in return for shorter fermentation run times and higher productivity over the long term.

## ANTIBIOTIC

Pea flour and purified pea protein successfully supported the growth of antibiotic-producing organisms, but had mixed results in the production of antibiotics. In this study, pea protein increased antibiotic production in one case, but failed to in another. A wider array of antibiotic-producing microorganisms will need to be tested to understand the role of peas as fermentation media for antibiotic production.

*Pea flour and purified pea protein are being investigated as an inexpensive nitrogen source in three commercial fermentations.*

## BIOTECHNOLOGY APPLICATIONS

The production of recombinant proteins for human therapeutic use is already a multi-billion-dollar industry and the most rapidly expanding field in fermentations, located mainly in North America and Europe. The organisms used to produce recombinant proteins are *Pichia pastoris*, *Escherichia coli*, *S. cerevisiae* and Chinese hamster ovary (CHO) cells. As part of this experiment, *P. pastoris* and *E. coli* were examined. Pea protein successfully supported their growth. Many other bacteria and fungi could also be grown using either pea protein or hydrolyzed pea protein as their nitrogen source.

These results show that Manitoba peas, and possibly other pulses and their purified proteins, could find a market as a fermentation ingredient providing the nitrogen requirement for many microorganisms. Further research needs to be done to determine whether this would be economically viable.

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