

MARKET OPPORTUNITIES ANALYSIS FOR CANADIAN SOYBEANS

Section 2

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Soybean Peroxidase

Soybean seed coats or hulls have a protein content of 0.5% and are added back to soymeal following oil extraction to increase the fibre content of the meal. This provides a value to soybean hulls equal on a per weight basis to soymeal.

Soybean peroxidase represents 3% of the total protein content of soybean seedhulls. Horseradish peroxidase has been used widely in a broad range of diagnostic kits, coupled with glucose oxidase as a colour indicator. Soybean peroxidase is more heat stable than horseradish peroxidase and thus provides a functional improvement for commercial applications. We have used the available data to determine the relative value of soybean peroxidase per bushel of soybean. Unfortunately, we have not yet been able to determine the cost of commercially extracted soybean peroxidase, but we have provisionally estimated it at \$250.00/bushel for pharmaceutical grade peroxidase.

Table 13: Calculation of amount of soybean peroxidase extractable from soybean hulls

Soybean peroxidase inputs

Cost of soybean grain	\$8.50	\$/bu
Soybean hull yield	1.15	lbs/bu
Peroxidase concentration	3%	% of total protein
Extractable total protein in seed hulls (0.5%)	5	g/kg of hulls
Extractable total protein in seed hulls (g/bu)	2.61	g/bu
Peroxidase extracted from hulls/bu	78.24	mg/bu
Cost of peroxidase extraction	\$250.00	\$/bu

We have used the commercial catalogue price for horseradish peroxidase to estimate the potential market price and market opportunity for soybean peroxidase.

Table 14: Estimated value of soybean peroxidase per bushel of soybean

Value

Commercial price for horseradish peroxidase	\$/2,000
Activity	\$41.30 units
Price/mg	250.00 units/mg
Value of soybean peroxidase	\$5.16 \$/mg
Operating margin for soybean peroxidase	\$403.94 \$/bu
	\$153.94 \$/bu

These estimates concern a pharmaceutical grade market and as such while the margins are compelling, the overall volume required would not be expected to be large.

A larger scale, industrial application for soybean peroxidase has been patented by Enzymol International (Ohio). They have been issued U.S. patent number 5,491,085 relating to the use of soybean peroxidase as a substitute for formaldehyde in the formation of phenolic resins. Phenolic resins based on formaldehyde reactions are used to glue fibres together in fibre boards such as plywood and particle board. Currently phenol is reacted with formaldehyde resulting in a phenolic resin. This is not an environmentally friendly reaction, especially as a significant proportion of the formaldehyde is not consumed in the process and must be disposed of as waste or recycled. Soybean peroxidase can be substituted completely for formaldehyde. We have estimated the potential size of this market for Canada.

Table 15: Scale of the soybean peroxidase opportunity in phenolic resins in Canada

Market size

Resin market (Canada)	374	Kt
Phenolic portion of resin market	32%	
Phenolic resin market (Canada)	119.68	Kt
Phenolic resin market (Canada)	108,572	MT
Peroxidase use (per 100g of resin)	5	Mg/100 g of resin
Peroxidase use (per MT of resin)	50	g/MT
Potential peroxidase use Canadian market	5,429	Kg

The soybean peroxidase used for this application would not need to be as concentrated as it would for the previously analyzed pharmaceutical market. Enzymol International has also demonstrated that a simple freezing and thawing of soybean hulls results in almost complete deactivation of other enzyme activities. Soybean hulls following the freeze/thaw cycle can be directly added to phenol. The additional fibre present would simply augment the fibre content of the particle board synthesized. This process reduces the cost of soybean peroxidase extraction to a negligible amount. We have calculated the market value of peroxidase used in this process on the basis of cost competitiveness with formaldehyde. There is 1/4800th as much soybean peroxidase required on a per weight basis to form phenolic resins as compared to formaldehyde, thus if the market price for formaldehyde is \$280/MT, then the comparable market price for soybean peroxidase is \$1.35/g.

Table 16: Analysis of market opportunity for soybean peroxidase in phenolic resins

<u>Market analysis</u>		
Soybean peroxidase value	\$1.35	\$/g
Market penetration	40%	
Premium	\$0.10	\$/bu
Soybean required	27,682,815	bushels
Soybean required	753,404	MT
Soybean acres required	820,185	acres
Value	\$2,768,281	\$/year

At this point this market would possess no incremental value for Canadian soybean producers, as the processors would be purchasing soybean hulls directly from crushers. There is potential to create value for producers by increasing the amount of soybean peroxidase expressed in the seed coat. Given the estimated low cost of extraction, the market driver for increasing soybean peroxidase levels would be limited availability. It is difficult to estimate the potential value of such a premium at this point in time as it would be set by competition among companies for access to feedstock. Given a value of \$0.11 per bushel at the current expression level of 78.44 mg/bu, a doubling of expression level would increase value by \$0.10/bushel. In a competitive model this entire value would be shared by the producer and whomever owns or delivers the increased expression level. This incremental value would equal a net present value of \$18.7 M given market entry in 2004, and peak market penetration (40% of the market opportunity) ten years after market entry.