The Cost of the Journey

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May 2002

Introduction

The following is a description of the costs associated with commercializing a soybean that produces oil with a different fatty acid composition than conventional soybean oil. The purpose of this article is to describe the reasons for the difference in cost between a conventional soybean oil and an oil that requires identity preservation (IP). The principles discussed apply to any novel soybean oil product developed by conventional breeding or by genetic engineering.

The IP oils discussed were developed by conventional breeding. One oil has half the saturated fat of conventional soybean oil and has been marketed commercially since 1997 under the brand LoSatSoy™ or under other brands as a low saturated soybean oil. Reduction of saturated fat content in food is desirable for prevention of cardiovascular disease. The second oil has had the linolenic acid reduced from about 8% in conventional soybean oil to as low as 1% in the new oil. The reduction in linolenic acid is intended to eliminate chemical hydrogenation of soybean oil for production of some foods. Hydrogenation causes the formation of trans-fatty acids that increase the risk of cardiovascular disease.

Retail considerations for commodity and IP soybean oils

Hy-Vee, Inc., a Midwest grocery chain headquartered in Des Moines, Iowa, was the first to offer low saturated soybean oil to its customers in 1997. A customer who shops at a Hy-Vee store has the choice between its traditional brand of commodity soybean oil labeled as vegetable oil and the IP product labeled Hy-Vee Grand Selections, Pure Low Saturated Soybean Oil.

The food manufacturer or marketer prefers products that are available on demand at a predictable price. It is important to Hy-Vee's store managers that the two types of soybean oil are always available to the customers. A basic principle of marketing is that once a new product is introduced to customers, it should always be available when they want it. If the supplier cannot meet the demand and the product is not available at all times, the customer probably will switch to another brand.

Hy-Vee does not want the responsibility of assuring reliable supplies of a product. The company wants to place an order for the required number of bottles of oil and have it

delivered on time. It cannot afford the space to store large quantities of the product in its distribution centers. These expectations can be readily met by the supplier of a conventional soybean oil. For the supplier of a low saturated soybean oil, these expectations create significant logistical problems that add cost to the product.

Production and marketing of a commodity soybean oil

Hy-Vee's source of conventional soybean oil is a company that refines and bottles the product for many grocery store chains. The crude soybean oil it needs can be purchased from multiple suppliers at a competitive price and delivered in the desired quantities on demand. The oil is refined and bottled in the same facility. When an order is received from Hy-Vee, the label on the bottling line is changed to the Hy-Vee label. There is no need to clean out the equipment to bottle different brands of conventional soybean oil.

Companies that deliver conventional crude oil to refiners and bottlers have large facilities in the major soybean growing areas of the United States that extract oil from thousands of bushels of grain each day. They obtain the grain from area grain companies that purchase it from farmers. The conventional soybeans produced by farmers are purchased by the grain companies and dumped together in large storage bins until the grain is shipped by train or trucks to an oil extraction facility. The grain company does not care what variety of soybean a farmer grows or how it is produced.

Farmers who produce conventional soybeans can grow any variety they choose from a number of seed companies. They can select varieties that have the yield, pest resistance, and other traits best suited for their fields. When they plant the soybeans, they can put one or more varieties in a field. If they run out of one variety, they can put another variety in the planter without cleaning it out. They can harvest different varieties in the same field or different fields without stopping to clean out machinery. The grain can be put in wagons or trucks without concern about which varieties were in the previous loads. The grain from different fields can be mixed together in on-farm storage bins. The stored soybeans can be sold and transported to the local grain company whenever the farmer chooses.

Seed companies compete to sell conventional soybean varieties to farmers. They know that more than 50 million acres of commodity soybeans will be grown each year in the United States. They know that farmers want varieties that have high yield, resistance to important pests, and other desirable production characteristics. When seed companies breed a new variety, they think about the characteristics the farmer needs to get the most production. If a company is successful, it can sell millions of bushels of soybean seed a year.

Conventional soybean production and utilization in the United States is designed for large volumes of undifferentiated grain. The system makes it possible for Hy-Vee and every other marketer of conventional soybean oil to have their product on hand for the consumer at all times at the lowest price possible without any hassles.

Production and marketing of an identity-preserved (IP) oil

IP soybean oil is a nuisance for a system designed to handle conventional soybean oil in large volumes. Every participant in the production and marketing chain expects to be paid for the inconvenience of keeping the grain and oil separate. This adds to the cost of the oil for the food manufacturer and marketer.

Program management

One cost for an IP oil program is for the individual who coordinates the multiple steps in delivering a finished product to the consumer. It involves scheduling of seed production, contracting of acreage for grain production, scheduling of grain delivery to the oil extraction facility, shipment of crude oil to the refinery, shipment of refined oil to the bottler, and shipment of bottled oil to the marketer. Assume that the salary, benefits, and operating expenses for the individual are $100,000 a year. If 1 million pounds of oil are sold each year, the added cost compared with conventional oil would be 10 cents a pound. The cost can be reduced by increasing the volume of IP oil sold.

Seed production

A successful IP oil program requires varieties that yield as close to that of conventional varieties as possible and that are acceptable to the farmer. A major challenge is to convince seed companies to invest in the development of IP oil varieties. The soybean breeder must choose between investing limited research dollars in conventional varieties for which there is a large market or IP oil varieties that have a small or unknown market. To date, only Pioneer Hi-Bred International, Inc. has made a major investment in developing IP oil varieties. They estimate that their total investment since 1991 has been in excess of $7 million. The current production of IP oil varieties is less than 50,000 acres. The small acreage has discouraged investment by other companies. The research director for a major seed company has indicated that it will not make any significant investment for development of IP oil varieties until they are grown on at least 500,000 acres.

If the seed company is willing to invest in developing IP varieties, it will need to recover its cost and make a profit. A technology fee is charged for varieties that have been genetically engineered for resistance to the herbicide glyphosate, commonly referred to as Roundup Ready® soybeans. Farmers decide if they want to grow less expensive varieties that are not Roundup Ready or pay the added cost of the technology fee to get Roundup Ready varieties. In a similar manner, a technology fee for IP oil traits may add cost to the oil. Assume that the technology fee for an IP trait is equivalent to $1.00 per acre. It is common to get at least 10 pounds of oil from a bushel of grain and 40 bushels of grain from an acre, which would be equivalent to 400 pounds of oil per acre. The cost of a $1.00 technology fee per acre would add 0.25 cents to a pound of IP oil.

Grain production

One of the largest added costs for IP oil is the premium paid to farmers to produce the grain. The three primary components of the premium are the extra work required for identity preservation, any yield penalty associated with the IP oil varieties, and the risk of meeting a quality standard.

The cost of identity preservation includes the time devoted to negotiating a production contract; keeping records of where grain was produced and stored; and cleaning planting and harvesting equipment, grain transporters, and grain storage facilities. About 10 pounds of crude oil can be obtained from a bushel of soybeans. Every 10 cents per bushel premium paid to the farmer adds about 1 cent to the cost of a pound of IP oil. For a premium of 30 cents a bushel, which is common for IP grain when there is no yield penalty associated with the variety, the added cost to the IP oil will be 3 cents.

When IP oil varieties yield less than conventional varieties, additional premiums must be paid to the farmer to cover the anticipated difference in production. When the market price is $5.00 for a bushel of grain, every bushel per acre of yield penalty costs the farmer $5.00 an acre. If 400 pounds of oil are obtained from an acre, the additional $5.00 per acre premium needed to cover the one bushel per acre of yield penalty would add 1.25 cents to a pound of IP oil.

The risk of failing to meet the quality standard for an IP oil is a factor the farmer will consider. If failure to meet the standard is due to environmental conditions beyond the control of the farmer, the cost of losing the premium for the grain will have to be borne by the farmer or the contracting agent. This is particularly true for the low saturated oil because it must comply with standards established by the Food and Drug Administration.

Contracting acreage with farmers adds cost to an IP oil. There will be costs associated with developing an acceptable contract document and promotional material, arranging meetings, and being available to answer questions. Assume that someone is paid $1 for each acre that is contracted. If 400 pounds of oil are obtained per acre, the added cost to the IP oil will be 0.25 cents.

Oil extraction

Before contacting farmers, it will be necessary to decide where extraction of oil from the IP grain will take place. Grain production should be as close to the oil extraction facility as possible to minimize the cost of transportation. Selection of a production area will depend on the region for which there are suitable IP oil varieties that farmers can grow successfully and where there is an oil extraction facility that can handle the IP grain at a reasonable price. An experience with the commercialization of the low saturated soybean oil illustrates the importance of these decisions. In the spring of 1997, Pioneer Hi-Bred decided to grow an IP variety near oil extraction facilities in Iowa and Michigan. Due to time constraints, final arrangements for the oil extraction in Iowa were not completed by the time the variety was planted. The oil extraction company decided that it wanted more than $1 a bushel to process the grain, which would have added at least 10

cents a pound to the cost of the IP oil. It was less expensive to have the Iowa grain shipped to Michigan for oil extraction.

It is necessary to coordinate the timing of grain delivery to the oil extraction facility, delivery of the extracted oil to the refiner, and bottling of the refined oil to meet the purchase schedule of the end user. The timing and volume of purchases by the end user will determine the schedule for oil extraction and refining. That is not an easy thing to do when a new oil product is commercialized because the end users are not likely to know for certain if consumers will accept the product. Someone will have to speculate on how much oil will be needed and accept the financial responsibility if the oil is not purchased. This financial responsibility may add cost to the IP oil.

The IP grain has to be stored until it is processed. Storage can take place on the farm, at a grain company, or at the oil extraction facility. If farmers choose to deliver their grain at harvest, the grain company or oil extraction facility must be able to segregate it from conventional soybeans. As the grain is delivered, it should be tested for its fatty acid composition to minimize the risk that conventional grain is delivered instead of IP grain or that there is mixture of the IP grain with conventional grain. Instruments are available to rapidly analyze samples from a load of grain before it is dumped into a storage facility. The purchase or rental of the instrument and labor for conducting the analysis adds cost to the IP oil.

The grain company or oil extraction facility will expect to receive a premium for the work involved in testing the grain as it is delivered, storing it separately from conventional soybeans, and underutilization of facilities when the amount of IP grain does not fill a storage bin. Grain companies may charge for liability insurance to protect them when accidental contamination of the grain prevents it from meeting standards for fatty acid composition.

The cost of oil extraction depends on the type of facility used. The two types of oil extraction are hexane extraction and expeller extraction. For large-scale oil extraction, hexane is added to the crushed soybeans to dissolve the oil from the grain. The process is effective in removing most of the oil, which is between 10 and 11 pounds per bushel. The primary problem with hexane extraction is that the facilities are not designed for handling small quantities of IP grain. The only two hexane extraction facilities in the Midwest that process smaller quantities of IP grain are Zeeland Soya at Zeeland, Michigan, and Crestland Cooperative at Creston, Iowa.

For expeller extraction, the oil is squeezed from the grain under high pressure. Expeller facilities are well-suited for processing the small quantities of grain used for initial evaluation of an IP oil. Expellers are not used for large-scale extraction because they remove only 6 to 7 pounds of oil per bushel. The rest of the oil remains in the protein meal. Expeller facilities are used for processing grain to obtain protein meal for livestock feed when the residual oil in the meal is of value to the livestock producer. They are located throughout the soybean growing areas of the United States.

The cost of obtaining IP oil from the two types of facilities is a function of the amount of oil that each can recover from a bushel of grain and the cost of the grain as influenced by premiums paid to the farmer. Assume that the goal is to obtain 1 million pounds of crude oil and that the farmer is paid a premium of 30 cents per bushel. If the hexane extraction facility obtains 10.5 pounds of oil per bushel, 95,238 bushels would be required. The total premium for those bushels would be $28,571, which would add 2.9 cents to a pound of oil compared with conventional oil. An expeller facility that could obtain 6.5 pounds of oil from a bushel would require 153,846 bushels to obtain 1 million pounds of oil. The total premium on those bushels would be $46,154, which would add 4.6 cents to a pound of IP oil.

The premium charged for extraction of IP oil relates to the cost of interrupting the processing of conventional soybeans. There are two strategies for dealing with the interruption. One strategy is to shut down the equipment, clean out the conventional soybeans, process the IP grain, and resume processing of conventional soybeans. This procedure assures that all of the IP oil is captured. The procedure is not used because of the cost of labor for cleaning and the revenue lost while the equipment is not operating.

The most common procedure for oil extraction is referred to as processing on the run. Without stopping the equipment, conventional soybeans are stopped from flowing into the extractor and the flow of IP grain is begun. The oil extracted during the time that the IP grain is replacing the conventional grain is put with the conventional oil. The IP oil is not captured until the IP grain has replaced the conventional grain in the extractor. When the remaining supply of IP grain is not sufficient to keep the extractor running at full capacity, the conventional grain is reintroduced and capture of the IP oil is stopped.

The amount of IP oil lost at the beginning and end of the run depends on the capacity of the extractor. The cost of not capturing all of the IP oil is the premium paid for the grain and includes the expense of contracting acreage, the farmer premium, grain transportation, and storage. Assume that the oil from 1,000 bushels of IP grain is not captured at the beginning and end of a run to obtain 100,000 pounds of oil from 10,000 bushels. If the premium per bushel for the grain is 50 cents, the total cost of premium for the 2,000 bushels will be $1,000. The $1,000 would be charged to the 100,000 pounds of oil for an added cost of 1 cent per pound of IP oil.

In addition to the cost associated with not capturing all the oil, the processor will incur expenses for storage of the IP grain, coordinating the timing of the processing with that of refining, organizing the transportation of the crude oil to the refiner, and other inconveniences. These factors will add to the cost of IP oil.

Oil refining

After crude oil is extracted from the IP grain, it is delivered to a refiner in tanks that are specifically for transport of food-grade oil. A truck tank holds about 45,000 pounds

and a railroad tank about 170,000 pounds. There may be extra charges for transportation of the IP oil if the closest refiner cannot be used because it is not equipped to handle small volumes.

When the oil reaches the refiner, it cannot be unloaded into storage unless the volume is large enough to justify cleaning out a tank used for conventional oil. When the crude IP oil remains in the delivery tanks until it is unloaded for refining, the time between delivery and refining must be as short as possible to minimize extra charges for keeping the tanks from being used for other shipments.

It is not practical to completely clean out a large-scale refiner between different types of oil, so refining of IP oil is done on the run. The principle is the same as extracting oil on the run. The flow of conventional oil is stopped and the IP oil is introduced into the refiner. The refined IP oil is not collected until is has flushed out the conventional oil. Collection of the IP oil stops when it is necessary to reintroduce the conventional oil to keep the refiner operating at maximum capacity. The oil that cannot be collected at the beginning and end of the run adds to the cost of the refined IP oil. Assume that 200,000 pounds of crude oil are refined and 10% (20,000 pounds) cannot be captured as refined oil. If the crude oil has a premium of 7 cents a pound, the cost of the premium for the oil that is not captured is $1,400. That adds 0.8 cents per pound to the cost of the 180,000 pounds of refined IP oil.

Refined oil loses quality because most of the antioxidants are removed during refining. The ideal arrangement is for the oil to be packaged into bottles or other containers at the same facility as soon as it is refined. If it has to be shipped elsewhere for packaging, it needs to be sealed under nitrogen to minimize the loss in quality. There will be added cost if the refined oil must be transported to another facility for packaging, particularly if it is a considerable distance from the refining facility.

Oil distribution

The inability to extract, refine, and package IP oil on a continuous basis may make it necessary to store the packaged oil longer than a commodity product. The extra storage costs can add to the price of the IP product.

Insurance

One variable that is difficult to control in the production of IP oil is the number of bushels that will be produced in a crop season. If the goal is to have enough oil to meet the demand, it is necessary to grow sufficient acres to have enough grain, even if the weather is unfavorable. This results in excess grain when favorable growing conditions produce high yields. If the excess grain is sold at commodity prices or is stored for future use, there is extra cost for the IP oil.

Total added cost for IP oil

Low saturated soybean oil has been provided to schools in the United States since 1997 through the USDA School Meals program. The difference in the amount charged for low saturated oil and conventional oil represents the total added cost for producing an IP oil.

The current price charged to Iowa schools through the USDA School Meals program for a case of six 1-gallon bottles of regular soybean oil is $15.11 and for low saturated soybean oil is $25.18. The six 1-gallon bottles contain 46.2 pounds of oil. The cost per pound is 32.7 cents for the regular soybean oil and 54.5 cents for the low saturated soybean oil. The total IP cost for the low saturated oil is 21.8 cents a pound.

Reducing the cost of IP oil

It will not be possible to achieve a significant market for IP soybean oil when it costs 21.8 cents per pound more than commodity soybean oil. Instead of paying the price for an IP soybean oil, food manufacturers and consumers can choose a lower cost alternative that has a similar fatty acid composition, including canola, corn, and sunflower oils.

The only way to markedly reduce the price of IP oil is to reduce costs in each step of the IP program with the goal of developing a commodity product. There are barriers to achieving the goal for each step of the IP program.

Program management

The cost of program management can be reduced by lowering expense or spreading the expense across a larger volume of oil. Increasing the volume of oil is the most likely way that the cost of program management can be reduced. With expenses of $100,000 a year and a volume of 1 million pounds of oil, the IP cost is 10 cents a pound. At a volume of 100 million pounds, the cost is reduced to 0.1 cents a pound. A volume of 100 million pounds could be obtained with about 250,000 acres of production.

Seed production

One of the most important barriers to achieving lower IP costs is development of IP varieties with production characteristics equivalent or superior to conventional varieties to avoid a yield penalty.

Only two major companies in the Midwest, Pioneer and Monsanto, currently are breeding IP oil varieties, and their investment is very small compared with their investment in development of commodity varieties. A seed company cannot afford to develop varieties for an IP market, unless the volume of seed sales is enough to offset the cost of research or the price of IP seed is sufficiently higher than commodity seed. It takes at least six years from the time a breeder begins to develop varieties with a certain trait to the time when substantial supplies of seed are available for planting by farmers. From now until 2008, it is highly unlikely that IP oil varieties in the Midwest will be equivalent in performance to commodity varieties. The difference between the two types

of varieties will continue beyond 2008, if seed companies do not markedly increase their investment in development of IP varieties. This will only occur if there is evidence that the demand for varieties with modified fatty acid composition will increase substantially in the future.

There is no indication that the demand for a soybean oil with low saturated fat will increase substantially. Although consumption of less saturated fat is encouraged by nutritionists, they do not suggest in their literature that low saturated soybean oil is an alternative to conventional vegetable oil that consumers should consider. Instead, they suggest that canola or other oils are preferred choices. It would take an expensive promotional effort to get nutritionists and consumers to consider low saturated soybean oil as an alternative to vegetable oil or canola. There is no evidence that anyone is willing to underwrite the cost of such a promotion. As a result, low saturated soybean oil likely will remain a small niche market that seed companies will not consider for variety development.

The future demand for an oil with reduced linolenic acid is not clear. It is not certain that a reduced linolenic oil would be able to replace hydrogenated oil without negatively influencing the quality of the food product. It also is not clear when the Food and Drug Administration will require labeling for trans-fatty acids. Proposed deadlines for implementing the labeling requirement have been changed to later dates, which makes it impossible to predict when trans-fatty acids will be brought to the attention of consumers through labeling. Without strong consumer pressure to eliminate hydrogenation, it is not likely that there will be a substantial demand for a soybean oil with a fatty acid composition that can replace hydrogenated oil. The consequence is that seed companies have little motivation for investing in development of varieties with modified oil.

Grain production

The largest barrier to reducing the cost of IP soybean oil is the premium paid to the farmer. Every 10 cents per bushel paid to the farmer for IP grain adds about 1 cent to a pound of oil.

The farmer is fully justified in expecting a premium for IP grain. By producing conventional soybeans, the farmer can choose from the many varieties offered by seed companies. During the next decade, there will only be a few IP varieties from which to choose, and none of them may have the pest resistance or other production characteristics needed to maximize yield. If the farmer is to take a risk in growing IP varieties, some compensation will have to be provided. Compensation also is needed to pay for the extra work required to keep IP grain separate from conventional soybeans. Any yield difference between IP and conventional varieties requires an additional premium.

Oil extraction

The most effective way to reduce IP costs for oil extraction is to increase the number of bushels of grain that need to be processed. Cost will be reduced when storage

facilities are used only for IP grain and the storage units are filled to capacity. The loss of oil at the beginning and end of an extraction run will be insignificant when IP grain is processed continuously for an extended period of time.

Oil refining

The cost of oil refining and packaging will decrease as the volume of IP oil increases. The greatest savings will be realized when the volume is sufficient to have the refining process carried out over an extended period of time and the refined oil is packaged on site. An extended refining period will reduce the loss of IP oil at the beginning and end of the run. Packaging at the location of refining will reduce transportation and other related costs.

Oil distribution

Distribution of the packaged IP oil will be simplified as the volume of oil increases sufficiently to have frequent extraction, refining, and packaging runs that will make the product available on demand with minimal storage.

Insurance

The need for insurance will be reduced when demand for the IP oil is known and there is reduced risk in matching the supply with the demand.

Converting an IP oil to a commodity oil

The ideal way to reduce IP oil costs is to make the new oil a commodity. Rapeseed oil was modified to improve its nutritional value and the new product became canola. This success story makes it tempting to assume that the same conversion could take place with soybeans that have a modified oil composition.

The reason that canola became a commodity is that the Canadian government mandated that conventional rapeseed oil could not be sold as a food oil after a certain date. Public and private breeders switched from breeding conventional rapeseed varieties to breeding canola varieties. It is highly unlikely that a similar mandate would be instituted by the United States government to convert conventional soybeans to one with a modified oil composition.

If the food industry was willing to pay a large enough premium for a modified soybean oil to provide more additional profit to farmers, the demand for the new varieties would stimulate seed companies to invest in their development. The same outcome would occur if the food industry discounted conventional soybean oil to the extent that it became more profitable to produce grain with modified oil composition. Neither of these scenarios is likely to occur.

At present, the food industry provides encouragement to soybean farmers to invest in the development of a new soybean oil without providing adequate financial incentive. One source indicates that the most that the food industry is willing to pay as a premium for large volumes of a modified soybean oil is 5 cents a pound. That amount would not cover the cost of IP production and provides little incentive for making the transition from conventional soybean oil to one with improved oil composition.

The primary investment in developing new types of soybean oil that could replace conventional oil is by the soybean farmers through their check-off funds. Those funds may make it possible for public breeders to develop varieties that are close to conventional varieties in yield and other production characteristics. Even if there were public varieties with modified oil equivalent to conventional varieties, there are not enough check-off funds to cover the premiums required for IP production during the transition to the new oil.