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Genetically Engineered High-Lauric Rapeseed (Canola): What Threat to Tropical Lauric Oil Producers?

ISSUE: Calgene, a California-based biotechnology company, is growing commercially a rapeseed (also known as canola) that has been genetically engineered to produce the lauric fatty acid—a product derived traditionally from tropical oils. If successful, lauric-producing rapeseed may be grown on a large scale in temperate regions of the North, displacing markets for tropical lauric oil producers.

IMPACT: Lauric oils are derived traditionally from coconut and palm kernel oils produced in the tropics. Coconut oil is the major source of lauric acid. The Philippines, the world's largest exporter of coconut oil, accounts for approximately 66% of global exports. Aside from being a major income producer, the coconut industry provides direct or indirect employment for 21 million Filipinos, about 30% of the country's population.

ECONOMIC STAKES: Globally, lauric oil consumption is about 4.6 million metric tons per annum. The United States is the largest importer. U.S. imports of tropical lauric oils exceeded 1.2 billion lbs. in 1992, valued at over \$350 million.

WHEN: In 1994, the U.S. government gave Calgene regulatory approval to grow its genetically engineered, high-lauric rapeseed on a commercial scale. The company's genetically engineered rapeseed is now growing on approximately 2,000 acres in the southeastern U.S. The crop will be harvested in June-July, 1995 and the lauric oil will be sold to Procter & Gamble—one of the world's largest buyers of lauric oils.

Introduction

In 1989, the editors of *Genetic Technology News*, a biotechnology industry newsletter, predicted that genetically engineered oilseed crops "could take over 20% of the U.S. market for major tropical oils."¹ This forecast was made long before genetically engineered oilseed crops became a commercial reality. In mid-1995, U.S. farmers will harvest the first commercial transgenic oilseed crop—a rapeseed that has been engineered to produce a lauric fatty acid—traditionally derived from tropical oils.

What threat does high-lauric rapeseed pose to producers of tropical lauric oils? This issue of the *RAF Communique* examines Calgene's genetically engineered, high-lauric rapeseed crop, and the potential impact on coconut oil exporters of Southeast Asia.²

What is lauric oil, and what is it used for?

Lauric is the principal fatty acid found in coconut and palm kernel oil. These vegetable oils are commonly known as "lauric oils." Traditionally, coconut and palm kernel oil from the tropics are the only high-volume source of lauric oils. Together, the Philippines and Indonesia account for approximately 81% of global coconut oil exports.

Lauric oils are used mainly for industrial purposes. Most lauric oil is purchased for non-edible uses, but it is also used as an ingredient in confectionery fats and oleochemical products. Lauric acid is a key raw material in the manufacture of detergents, soaps, lubricants, cosmetics, and other personal care products. It is an essential ingredient in promoting the lathering of soaps and mildness of detergents, for example.

**U.S. Imports of Lauric Oils (Coconut and Palm Kernel Oils)
1990-1993**

| YEAR | Coconut Oil Imports (metric tonnes) | Value of Coconut Oil Imports (US) \$1,000 | Palm Kernel Oil Imports (metric tonnes) | Value of Palm Kernel Oil Imports (US)\$1,000 | Total Value of Lauric Oil Imports in (US) |
|-------------|--|--|--|---|--|
| 1990 | 429,219 | \$134,539 | 138,766 | \$51,595 | \$186,134 |
| 1991 | 379,974 | \$205,365 | 155,372 | \$79,911 | \$285,276 |
| 1992 | 527,429 | \$226,756 | 137,198 | \$76,818 | \$303,574 |
| 1993 | 453,217 | \$207,053 | 137,691 | \$72,222 | \$279,275 |

Source: Mark Ash, USDA, ERS, Specialty Crops Branch, April, 1994.

Calgene's High-Lauric Rapeseed: A Northern Oilseed Genetically Engineered to Produce A Tropical Oil

In October, 1994 history was made when the world's first commercial genetically engineered oilseed crop—rapeseed with a 40% laurate content—was planted by farmers in Georgia (southeastern United States). The genetically engineered rapeseed is a patented product developed by Calgene, a biotechnology company based in California. High lauric rapeseed is the result of Calgene's 13-year research and development programme and strategic partnership with Procter & Gamble—one of the world's largest buyers of lauric oil.

According to Andrew Baum of Calgene: "The development of high-lauric rapeseed oil is a dramatic example of the power of genetic engineering. We were able to fundamentally change the chemical composition of rapeseed oil by engineering the rapeseed plant to produce a fatty acid it had never produced before."³

"We were able to fundamentally change the chemical composition of rapeseed oil by engineering the rapeseed plant to produce a fatty acid it had never produced before." -- Andrew Baum, Calgene

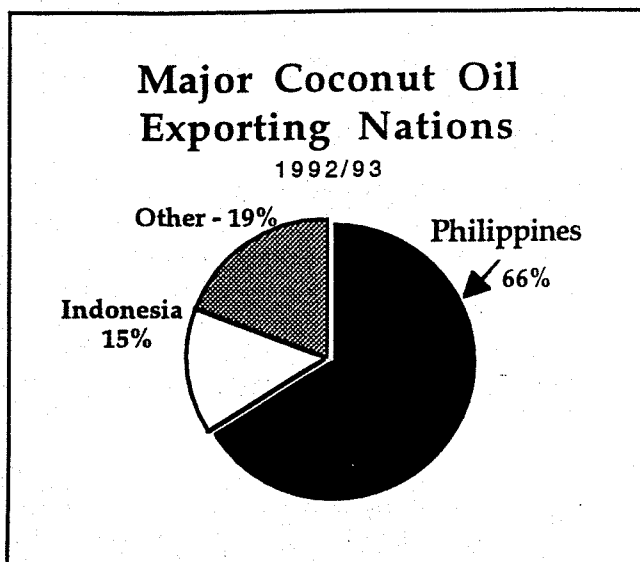
Calgene scientists created the designer oilseed crop by identifying an enzyme in another plant, the California bay laurel tree, that controls the production of lauric fatty acid. The bay laurel tree grows wild in California and has as much as 60% laurate in its seed oil. Once the enzyme was

identified and purified, the gene responsible for production of the enzyme was inserted into the DNA of rapeseed plants. The result is a transgenic (genetically engineered) rapeseed variety that produces 45% laurate by weight in the seed oil. Calgene will market its high-lauric rapeseed oil by the brand name "Laurical™."

In 1994, Calgene received a US patent for the expression of the laurate synthesis gene in genetically engineered plant oils. U.S. Patent No. 5,298,421 covers the expression of the thioesterase gene from the California bay tree in rapeseed and other temperate oilseed crops.

The first commercial-scale planting of high-laurate rapeseed involves about 25 farmers who are growing the crop under contract to Calgene on approximately 809 hectares (2,000 acres). The oilseed will be harvested June-July, 1995 and is expected to yield approximately 1.5 million lbs. of lauric oil.⁴ According to published reports, Procter & Gamble will buy at least one million lbs. of Calgene's high-laurate oil.⁵

The commercial success of Calgene's high-lauric rapeseed depends on whether or not the lauric can be produced at a price that is competitive with tropical producers. But lauric-producing rapeseed must also be agronomically competitive with non-genetically engineered rapeseed, "so that it is not necessary to pay significant premiums to the farmer to grow the crop."⁶ All of Calgene's specialty oilseed crops will be "value-added, identity-preserved," and therefore will be grown under contract with farmers.



Although many Third World nations are producers of coconut oil, only two countries dominate the global export market. Other exporting nations include, among others: Malaysia, Singapore, Papua New Guinea, Cote d'Ivoire, W. Samoa, Fiji.

Coconut: "Pillar of the Economy" or "Sunset Industry" for the Philippines?

The coconut industry is traditionally regarded as the "pillar of the Philippine economy." The coconut industry:

- accounts for about 44% of the Philippines' total agricultural export earnings, and 7% of total export earnings.
- provides direct or indirect employment for 21 million Filipinos, about 30% of the country's population. Most coconut producers are smallholders who grow the perennial trees alongside other crops.

The bulk of the Philippines' coconut production is exported. In 1992, 72% or 1.6 million metric tonnes (in copra terms) was exported. Copra and coconut oil comprised 92% of the coconut products exported for that year. [Note: Copra is the dried white flesh of the coconut from which the coconut oil is extracted.]

In recent decades the Philippine coconut industry has been plagued by a series of discouraging events. These include: perennial low prices, aging coconut trees, steep competition from Malaysian palm oil and an overall decline in the share of coconut oil in the world fats and oils market, and a highly effective anti-tropical oil campaign in the United States. As a result, some Filipino observers grimly

refer to the coconut industry as "the sunset industry"--and suggest that it is time to consider shifting away from the production of coconuts. The threat of Calgene's high-lauric rapeseed adds yet another depressing scenario--a Northern oilseed crop that produces high levels of lauric--the same fatty acid found in coconut and palm kernel oil. Will lauric rapeseed produced in the North displace or eliminate the market for tropical coconut oil?

Despite the threat of losing export markets to competing oil sources, the Philippine government appears to be taking steps to modernize and revitalize its coconut industry. In his speech to the 1993 World Lauric Oil Conference, Philippine President Fidel Ramos announced that, "Our target is to increase production by 3-3.5 million tons a year through the year 2000, using financial support from the World Bank and other financial and technological sources."⁷

In 1990, the government of the Philippines negotiated a \$121.8 million loan from the World Bank to launch a "large and ambitious project intended to rehabilitate the country's coconut industry."⁸ According to World Bank officials, the re-planting of coconut trees is behind schedule due to a shortage of planting material.⁹

What Impact on Tropical Lauric Oil Producers?

The amount of lauric oil (1.5 million lbs.) that is expected to result from Calgene's first commercial rapeseed crop represents a tiny, almost insignificant quantity when compared to the 1.3 billion lbs. of lauric oil imported into the United States in 1993. But this is only the beginning of what could become a thriving industry. Andrew Baum, President of Calgene's Plant Oil Division recently told the editors of INFORM that, "In another ten years, there could be 500,000 acres of specialty canola."¹⁰ (500,000 acres=202,429 hectares)

It is also important to note that Calgene is in the process of developing a second generation lauric rapeseed that will contain a much higher (70-80%) lauric oil content than today's variety containing 45% laurate. The new rapeseed, designed for the non-edible lauric oil market, will be commercialized in the next few years.

Officials of Calgene are cautious when asked to comment on the potential impact of high-lauric rapeseed on tropical lauric producers. According to Tony Del Vecchio, Director of Business Development for Calgene's Oil Division, the company's primary goal is to produce a lauric crop that will give American industry "a domestic, price-stable scenario with predictable long-term costs."¹¹ Del Vecchio explains that Calgene's goal is not to compete with coconut oil producers in all markets, but to target upscale, specialty uses of lauric oil.

At the 1993 World Conference on Lauric Oils in Manila, Calgene's Andrew Baum observed that "it is not clear whether or not high-lauric rapeseed oil will be supportive or detrimental to existing lauric oil suppliers."¹² Baum makes the case that Calgene's new lauric rapeseed could actually benefit existing producers of lauric oil: "It is our belief that the net benefit will be positive by dampening supply and price volatility which could actually lead to an expansion of the uses of lauric oil in the years to come."¹³

This could have devastating effects on the economy of the Philippines."

— Jesus L. Arranza, United Coconut Assoc. of the Philippines

Jesus Arranza, of the United Coconut Association of the Philippines offers a more sobering view of the potential impact of rapeseed-derived lauric oil. At the 1993 World Conference on Lauric Oils, Mr. Arranza observed:

"Should this happen [commercialization of Calgene's high-lauric rapeseed], lauric oil users would have more vegetable-oil options, and the coconut oil share of lauric oil exports would drop substantially. Lauric rapeseed would certainly have an advantage over other lauric oils, since the former is not a perennial crop. Thus, lauric rapeseed output may be increased in a relatively short time, depending on the requirements of the market. Also, since rapeseed is grown mostly in the European Community and Canada, and is beginning to be grown on U.S. farms, the decision to support an indigenous lauric oil in these areas is far more convenient than importing lauric oils from the tropics. This could have devastating effects on the economy of the Philippines."¹⁴

RAFI asked other lauric industry observers to give their opinion on the outlook for high-lauric rapeseed, and the potential impact on tropical producers of lauric oils:

"If high lauric rapeseed can be produced in the same price range, then it can be competitive with coconut oil. I think this should smooth out the price volatility [of lauric oils], but it may put some of the coconut producers in the Philippines out-of-business." -- Thomas H. Applewhite, Editor, Proceedings of the World Conference on Lauric Oils¹⁵,

"It will provide an alternative source of lauric oils—but it all depends on the price...it could be very promising." -- Robert J. McCoy, Procter & Gamble, retired, 1994¹⁶

"In my view, the uncertainty of there being adequate lauric oils supplies in the long-term is a major constraint to increased commitment to their use....IF, as is quite feasible, Calgene manage their lauric rape production to take advantage of predictable price peaks, the resulting reduction in price volatility could benefit all lauric producers." -- David J. Meadows, Senior Tree Crop Specialist, World Bank¹⁷

Vegetable Oil Wars

Ultimately, it is extremely difficult to predict future market shares for producers of vegetable oils worldwide. There is potential for dramatic shifts in agricultural production and trade due to genetic engineering of oilseeds. Many biotechnology companies are manipulating fatty acids to create new and alternative sources of oils and fats, as well as oilseeds with new and different agronomic characteristics.

Calgene's Laurical™ line of high-lauric rapeseed oil is only the first in a series of so-called "value-added proprietary plant oils" that Calgene and other biotechnology companies will produce and supply to the edible and industrial oil markets."¹⁸ It should be noted, for example, that Calgene collaborates with industrial giants such as Procter & Gamble, Unilever, Mobil Oil, and Nippon Steel in the development of edible and industrial plant oils. The following table offers a glimpse of future commercial oilseed products that may greatly alter the supply and demand for oilseeds worldwide.

Genetically Engineered Designer Oilseeds: What's in the Pipeline?

| Organization | Crop | Altered Trait | Target Year to be Commercialized |
|--|----------|---------------------------------|----------------------------------|
| AgrEvo Canada Inc. (Canada) | Rapeseed | Herbicide tolerance | 1995 |
| Calgene (USA) | Soybean | Herbicide tolerance | 1996 or 1997 |
| | Rapeseed | High-lauric | 1995 |
| | Cotton | Herbicide tolerance | 1995 |
| | Rapeseed | High-stearate | Latter part of 1990s |
| | Rapeseed | Medium-chain fatty acid | Latter part of 1990s |
| Dupont (USA) | Rapeseed | Cocoa butter alternative | Latter part of 1990s |
| | Cotton | Insect resistance (B.t.) | Latter part of 1990s |
| | Soybean | High-oleic, low-saturate | 1998-1999 |
| | Soybean | High-lysine | 1999-2000 |
| | Maize | High-oil, high-oleic | 1999-2000 |
| InterMountain Canola (USA) | Soybean | High-stearate, low-polystearate | 1999-2000 |
| | Rapeseed | High-oleic | 1996-1997 |
| | Rapeseed | High-oleic, low-saturate | 1998 |
| Monsanto Co. (USA) | Rapeseed | High-stearate, low-polystearate | 1997-1998 |
| | Soybean | Herbicide tolerance | 1996 |
| | Rapeseed | Herbicide tolerance | 1996 |
| Plant Genetic Systems (Belgium) | Cotton | Insect resistance (B.t.) | 1996-1997 |
| | Rapeseed | Transgenic hybrid | 1996 -1997 |
| Crop Development Centre, Univ. of Saskatchewan | Flax | Herbicide tolerance | 1995 |

Source: Adapted from table appearing in *INFORM*, published by the American Oil Chemists' Society, Vol. 6, No. 2 (February, 1995) p. 153

Conclusion

RAFI concludes that high-lauric rapeseed will displace some portion of the market for tropical lauric oils in the coming years. The Philippines is especially vulnerable because it dominates coconut oil exports worldwide. It is impossible to predict the precise impact of Calgene's high-lauric rapeseed on the Philippines and other tropical lauric oil producers. Ultimately, if the price of high-lauric rapeseed is competitive with tropical imports, industrial buyers of lauric oil in the United States will seek to buy domestically

produced oil and lessen their dependency on imports.

In 1995, Calgene's first commercial crop of lauric rapeseed will yield an estimated 1.5 million lbs. of lauric oil. This represents a very tiny proportion of the 1.3 billion lbs. of lauric oil imported into the United States in 1993. Nevertheless, it is important to consider factors that may contribute to increases in the acreage devoted to lauric rapeseed, and the quantity of lauric oils that may be produced in the future by genetically engineered varieties:

1) The 1995 crop is Calgene's first commercial planting of high-lauric rapeseed. If profitable, the acreage devoted to high-lauric rapeseed is expected to grow significantly. Company officials estimate that a total of 50,000 acres (20,243 hectares) of proprietary oilseeds could be grown in the Southeastern United States alone. Rapeseed has never been grown in this region of the United States before; it represents a new winter crop for Southeastern farmers.

2) Calgene is developing a second generation high-lauric rapeseed that will yield much higher levels of lauric (70 to 80%). If successful, second generation

varieties could increase lauric oil production dramatically.

3) Most rapeseed is grown in Canada and Europe. If Calgene's high-lauric rapeseed is competitive with other varieties of rapeseed, and if lauric-producing rapeseed can successfully compete with tropical sources, the crop could be grown in many regions of North America and Europe. Calgene is expected to expand laurate rapeseed production in the winter wheat growing areas of the upper midwestern United States and western Canada. (Total North American production of all rapeseed is approximately 10 million acres.)

Company Profiles

Calgene, Inc., based in Davis, California (USA) is an agribusiness biotechnology company that develops plant varieties and products for the seed, food and specialty chemical industries. Calgene's wholly-owned subsidiaries include: Calgene Chemical, Stoneville Pedigreed, and Calgene Fresh. The company has annual seed sales of approximately (US) \$18 million, and R&D expenditures in 1994 of \$17 million.

Procter & Gamble, based in Cincinnati, Ohio (USA) is one of the world's largest manufacturers of soaps, detergents and cosmetics, ranking # 34 on *Fortune* magazine's list of the world's largest industrial corporations. In 1993, Procter & Gamble had annual sales of (US) \$30,400 million.

¹Genetically Engineered Oilseed Plants: Route to Improved Vegetable Oils, New Products," in Genetic Technology News, March, 1989, p.11.

²Our analysis does not include the impact on palm kernel production. This is because palm kernel oil (primarily exported from Malaysia), is a by-product of palm oil. Malaysia is not dependent on palm kernel exports, because it dominates the production and export of palm oil worldwide—a market that far exceeds the lauric oils market.

³Baum, Andrew. 1994. "The Development and Commercialization of High-Lauric Rapeseed Oil" in Proceedings of the World Conference on Lauric Oils, ed. by Thomas H. Applewhite, AOCS Press, p. 52.

⁴Personal communication with Tony Del Vecchio, Director of Business Development, Calgene Oils Division, May, 1995.

⁵Anonymous, "Transgenic Oilseed Harvests to Begin in May," INFORM, Vol. 6, No. 2, February, 1995, p. 152.

⁶Baum, Andrew. 1994. "The Development and Commercialization of High-Lauric Rapeseed Oil" in Proceedings of the World Conference on Lauric Oils, ed. by Thomas H. Applewhite, AOCS Press, p. 53.

⁷Philippine President Fidel V. Ramos, "Climbing High with Coconuts," in Proceedings of the World Conference on Lauric Oils, ed. by Thomas H. Applewhite, AOCS Press, 1994, p. 2. Note: Ramos didn't actually deliver the speech at the meeting.

⁸David J. Meadows, World Bank, in Proceedings of the World Conference on Lauric Oils, p. 23.

⁹Information received from David Meadows, World Bank, via fax, May, 1995.

¹⁰Andrew Baum was quoted in "Calgene Marks Planting of Transgenic Canola," INFORM, Vol. 6, No. 1, January, 1995, p. 82.

¹¹Personal communication with Tony Del Vecchio, Director of Business Development, Calgene Oils Division, May, 1995.

¹²Baum, Andrew, "The Development and Commercialization of High-Lauric Rapeseed Oil" in Proceedings of the World Conference on Lauric Oils, ed. by Thomas H. Applewhite, AOCS Press, p. 51.

¹³Baum, Andrew, op. cit., p. 55.

¹⁴Arranza, Jesus L., United Coconut Associations of the Philippines, "The Marketing and Economics of Coconut Oil" in Proceedings of the World Conference on Lauric Oils, ed. by Thomas H. Applewhite, AOCS Press, 1994, p. 13.

¹⁵Personal communication with Thomas Applewhite, 26 April 1995.

¹⁶Personal communication with Robert J. McCoy, formerly of Procter & Gamble, May, 1994.

¹⁷Personal communication with David Meadows, World Bank, via fax, May, 1995.

¹⁸"Calgene Receives U.S. Genetically Engineered Plant Oils Patent," Calgene News Release, 29 March 1994.