Potential Agriculture and Agri-food Business and Economic Impacts of Proposed Limits on Trans Fats in Canada

-- A Final Report --

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I. Introduction

Canadian consumers have always been mindful of the cost of food, though changes in society and a greater awareness of health impacts and environmental issues now play a larger role in the choices consumers make. Consumers in much of the developed world have moved toward healthier eating habits, at least to the extent that our busy lifestyles will allow. Lower fats, less sugar, and more fibre are changes that have been made in recent years.

The relationship between fat consumption and heart disease has been a subject of concern for decades. Research in the late 1940's research found a correlation between animal fat consumption and heart disease. The spurred the growth of vegetable oil production and consumption. During the late 1950's and early 1960's it became recognised that saturated fatty acids from vegetable oil sources were also harmful to health. This caused a move away from tropical oils toward the use of soybean, canola oil and other vegetable oils. These non-saturated vegetable oils were hydrogenated to create solid fats and to give the oils stability in frying and baking processes. The process of hydrogenation created Trans Fatty Acids (TFA) in these products.

Research during the 1990's resulted in a body of scientific evidence showing that TFA consumption raised LDL cholesterol levels in the blood stream, elevating the risk of coronary heart disease.

In response to recognition of the risk Canada and the US passed laws to require the mandatory labelling of trans fat content by December 2005. As a measure to further reduce these risks, a motion was passed in the House of Commons to establish a task force to develop a set of regulations within one year to restrict TFA to less than 2% in food products. Such regulations have the potential to increase economic costs faced by primary producers, oilseed crushers, food processors, food service enterprises and grocery outlets.

The ultimate goal of this study is to understand the potential economic and business impacts on the agriculture and agri-food sector that would occur if an outright ban or mandatory reduction in the use of trans fats was imposed on the Canadian food supply.

This study will attempt to inform readers regarding four areas:

1) The degree to which trans fats are apparent in the Canadian food system, and the Canadian diet.

2) The risks associated with the ingestion of trans fats.

3) Give examples and delineate outcomes resulting from trans fat bans in other jurisdictions.

4) The economic impacts that may arise given the implementation of a trans fat ban.

II. Background

Before the introduction of partially hydrogenated vegetable oils, butter, lard, tallow, palm oil and palm kernel oil, were the fats and oils of choice for most of the Canadian food industry. All of these fats are high in saturated fatty acids. Mounting evidence that saturated fatty acids increased the risk of coronary heart disease while fats high in mono-unsaturated fatty acids lowered the risk, prompted food manufacturers and food service groups to begin evaluating alternative fats and oils.

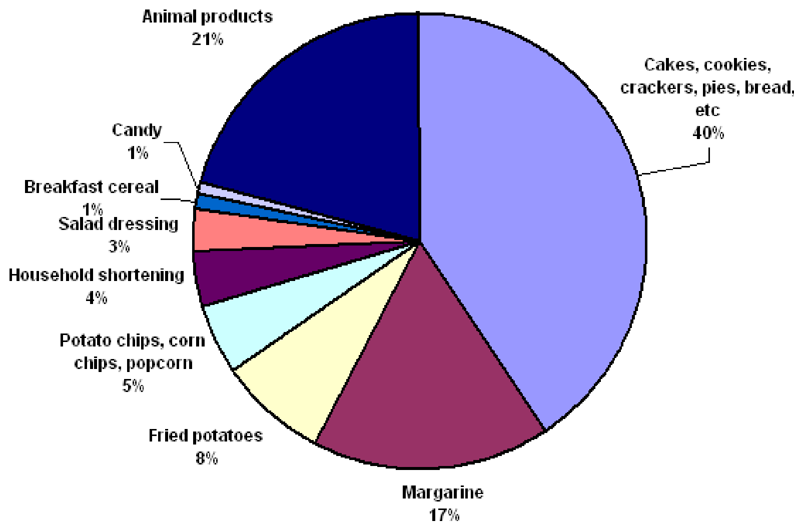
Vegetable oils, such as canola and soybean oils, with their high levels of linoleic acid, and low levels of saturates and a presence of essential fatty acids, were obvious healthy alternatives to highly saturated fats and oils; however, canola and soybean oils were not functional in most processed food products. With the high level of linoleic acid, neither oil was very stable when heated, both became rancid easily, they did not perform the way saturated fats did during processing and they did not provide the same sensory characteristics in the final food product. To provide these missing functional properties edible oil manufacturers hydrogenated the vegetable oils.

By controlling the level of hydrogenation, vegetable oils could be made suitable for use by all sectors of the food industry. What was not widely known at the time was that molecular changes occurred during the hydrogenation process. These changes created TFAs. Research has demonstrated that, not only do these industrially-produced TFAs increase levels of LDL-cholesterol in the blood, but they also lower the beneficial HDL-cholesterol levels, leading some researchers to conclude that gram for gram, trans fatty acids pose a higher risk for coronary heart disease than saturated fatty acids.

It is not possible to eliminate all trans fatty acids from the Canadian diet as they are produced naturally by bacteria in ruminant animals and found in the animal's fat. Common sources of natural trans fatty acids include meat from ruminant animals, milk, cheese and butter. However, various consumer and health organizations have been applying pressure on the food industry to reduce or eliminate the industrially produced trans fat from food products. Recently, the House of Commons voted to implement a regulation that would effectively eliminate industrially produced TFAs by limiting their levels in food products sold in Canada to the lowest levels possible, and created a trans fat task force to develop these regulations.

The lack of labelling rules in the past has made it difficult to precisely estimate daily TFA consumption. The US Food and Drug Administration (FDA) has estimated TFA consumption, but even these data are subject to change since the industry and consumers are now responding to upcoming labelling requirements. According to FDA, only 21% of the TFA intake comes from natural animal sources (meat, dairy) the rest comes from hydrogenised vegetable oils (FDA Consumer magazine, 2003). Figure 1 shows the sources of TFA in the American diet. Besides animal fat, 24% comes from visible fats like margarine, shortening, and salad oils (17%, 4% and 3% respectively); the rest is consumed through processed food items like bread, cookies, chips etc. The FDA estimates that the total daily TFA consumption is 5.8 grams per day in an average American adult's diet. Of this amount, 3.6 grams per day could be easily replaced by liquid vegetable oils for use in households and by food processing companies.

Figure 1 - Major Food Sources of Trans Fat Acids for American Adults



Source: FDA Consumer Magazine, 2003

Extrapolating the data contained in Figure 1 and applying it to Canadian consumption patterns, one can estimate the TFA intake of Canadians (see Table 1).

Table 1 - Trans Fat Consumption in Canada, 2001

	Total Annual Cons.[1] (Tonnes)	Individual Daily Fat Cons[2] (Grams)	TFA content[3]	Individual Daily TFA Consumption[4]	30% Intake[5]
Shortening	360,986	32.97	19.84%	6.54	1.96
Salad	617,944	56.43	4.00%	2.26	0.68
Margarine	128,736	11.76	20.14%	2.37	0.71
Lard	12,980	1.19	3.50%	0.04	0.01
Total	1,120,646	102.34	9.21%	11.21	3.36

Source: "Novel Functional Foods: Health Care Cost Savings due to Trans Fat Free Nexera Canola Consumption in Canada". Stavroula Malla. 2004.

[1] Source of Data: Statistics Canada, 2001

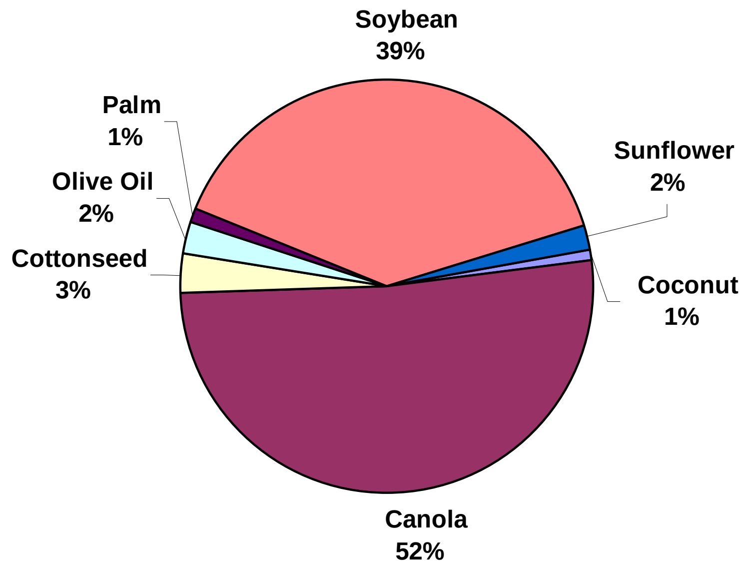
[2] The per day consumption is calculated from the total consumption divided by 30 million (population) and 365 to get individual daily consumption

[3] Trans Fatty acid content calculated previously

[4] Individual Daily TFA consumption is calculated by multiplying the Individual Daily Fat consumption multiplied by the TFA content by category

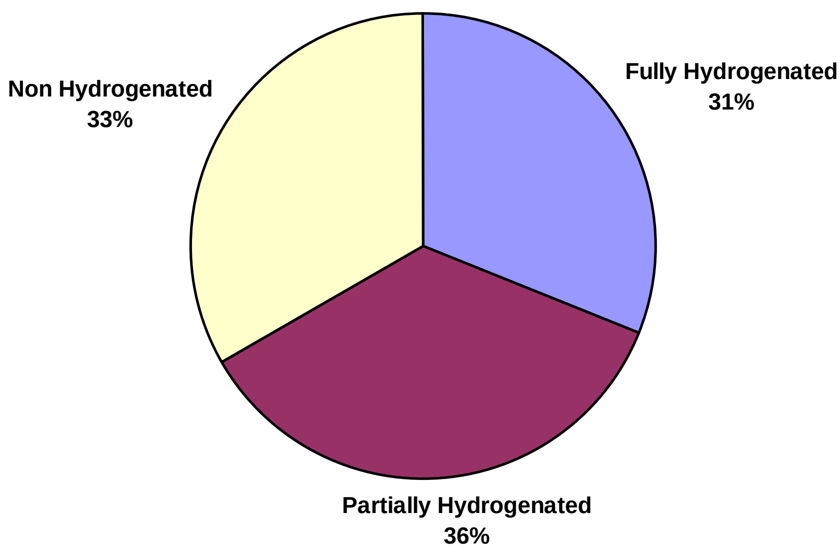
[5] We are assuming that only 30% of the total consumed oil is actual dietary intake. Much of the fat is thrown out after use rather than being consumed. In reconciling the difference between reported human use consumption of visible fats and the actual dietary intake, it is estimated that approximately 70% of these fats never reach the stomach of consumers.

Figure 2 - Total Canadian Vegetable Oil Consumption by Type*



Source: Dow Agroscience, publication date unknown

Figure 3 - Total Canadian Vegetable Oil Consumption by Level of Hydrogenation*



Source: Dow Agroscience, publication date unknown

Table 2 - Average Daily Intake of TFA's in 14 European Countries in 1996*

COUNTRY	AGE	*TRANS* FATTY ACID % ENERGY	*TRANS* FATTY ACID GRAMS PER DAY	PREVIOUS *TRANS* FATTY ACID INTAKE GRAMS PER DAY	PERIOD
Iceland	19-64	2.0	5.4		
Holland	19-64	1.6	4.3	10	1984-85
Belgium	18-63	1.4	4.1		
Norway	19-64	1.5	4.0	8	1984-91
United Kingdom	0-75 +	1.3	2.8	7	1982
Denmark	**19-64**	**1.0**	**2.6**	**5**	**1991**
Sweden	19-64	1.1	2.6	7	1984
France	19-64	1.2	2.3		
Germany	19-64	0.8	2.2	4	1991
Finland	25-64	0.9	2.1	3	1992
Spain	0-70 +	0.7	2.1	2	1988
Italy	1-80	0.5	1.6		
Portugal	38	0.6	1.6		
Greece	23-64	0.6	1.4		

*TRANSFAIR (62) and corresponding results from previous periods.
Source: Stender S., and J. Dyerberg, 2003. *The Influence of Trans Fatty Acids on Health*. Fourth Edition. A report from the Danish Nutrition Council. Publication 34. (http://www.ernaeringsraadet.dk/pdf/Transfedt_UK_ny.PDF). (page 37).

Table 2 illustrates the trans fat intake from table margarines in Europe. The highest daily intake of trans fat is in Iceland (5.4 grams) followed by Holland, Belgium and Norway. The lowest daily trans fat intake is in Greece (1.4 grams).

Table 3 – Average Trans Fat Intake of U.S. adults by Food Group

CSFII 94–96[1]	Men	Women	All	All
Mean daily energy intake, kcal[2]	2455	1646	2058	
Mean daily *trans* fat intake[3,4]				
Food group	Grams	Grams	Grams	% of energy
Hydrogenated products				
Total yeast bread	0.475	0.330	0.404	0.177%
Cakes, pies, doughnuts, sweet rolls, biscuits, muffins, quick breads, pancakes, waffles, tortillas	1.607	1.163	1.391	0.607%
Cookies, crackers	0.624	0.515	0.571	0.249%
Ready to eat breakfast cereal	0.093	0.074	0.084	0.037%
French-fried, home-fried potatoes	0.635	0.332	0.486	0.213%
Potato chips, corn chips, popcorn	0.345	0.215	0.281	0.123%

Pourable and mayo type salad dressing	0.161	0.136	0.159	0.069%
Total candy containing chocolate	0.048	0.040	0.044	0.019%
Total margarine	1.072	0.659	0.967	0.423%
Household shortening	0.277	0.222	0.250	0.109%
Total hydrogenated products	5.357	3.886	4.637	2.026%
Animal products				
Total milk, including on cereal	0.125	0.085	0.105	0.046%
Ice cream and ice milk	0.092	0.057	0.075	0.033%
Total cheese and cottage cheese	0.227	0.148	0.188	0.083%
Total beef, ground and not ground	0.569	0.319	0.447	0.195%
Total frankfurter and lunch meat	0.360	0.188	0.276	0.121%
Total fluid and sour cream	0.061	0.044	0.052	0.023%
Total butter	0.071	0.049	0.060	0.026%
Total animal products	1.505	0.890	1.203	0.527%
Total all products	6.862	4.776	5.840	2.553%

[1] Continuing Survey of Food Intakes of Individuals, 1994–1996
[2] kcal: kilocalories
[3] Source of trans fat content of foods: Ref. 40.
[4] Source of food intake data: Smiciklas-Wright H., D.C. Mitchell, S.J. Mickle, A.J. Cook and J.D. Goldman. Foods Commonly Eaten in the United States. Quantities per Eating Occasion and in a Day, 1994–1996. U.S. Department of Agriculture NFS Report No 96–5, pre-publication version, 2002. www.barc.usda.gov/bhnrc/foodsurvey/Products9496.html.

Source: Federal Register, Department of Health and Human Services, Food and Drug Administration, 21 CFR Part 101. *Food Labelling; Trans Fatty Acids in Nutrition Labelling; Consumer Research to Consider Nutrient Content and Health Claims and Possible Footnote or Disclosure Statements; Final Rule and Proposed Rule.* /Vol. 68, No. 133/Friday, July 11, 2003/Rules and Regulations. (page 414869).

Table 3 shows that average trans fat intake from partially hydrogenated vegetable oils is about 5.36 grams per day for men and 3.89 grams per day for women, or about 2.03 percent of energy. Adding the trans fat of ruminant origin gives an overall total trans fat intake of 6.86 grams per day for men and 4.78 grams per day for women, about 2.55 percent of energy. For comparison, FDA also calculated the trans fat intake based on CSFII 1989–91, using the same method as for the estimate based on CSFII 1994–96 (Ref. 116 and 117). The overall total trans fat intake from CSFII 1989–91 is 6.47 grams per day for men, 4.51 grams per day for women and 5.32 grams per day for all adults, or 2.71 percent of energy (not shown in Table 1).

It has been suggested that foods be limited to 2 grams of trans fatty acid for every 100 grams of fat, even though there is no scientific data to suggest what a safe or healthy limit would be (FDA 2003). The proposed limit would create issues for the food industry as some products using hydrogenated vegetable oils would require reformulation, a task that may require significant development time and expense. In addition, finding suitable alternative oils and fats that will function well during processing and provide the required sensory characteristics is difficult. The easiest solution for many in the food industry would be a return to the highly saturated fats and oils of the past, however, this does not address the health concerns since saturated fats are also known to increase the risk of heart disease.

The implementation of a trans fat ban may result in various short-term effects, including increased product costs or, in more extreme cases, the elimination of the product from store shelves. In the longer-term, such a measure may have impacts on the investment potential of Canada's food industry, its growth, profitability and competitiveness.

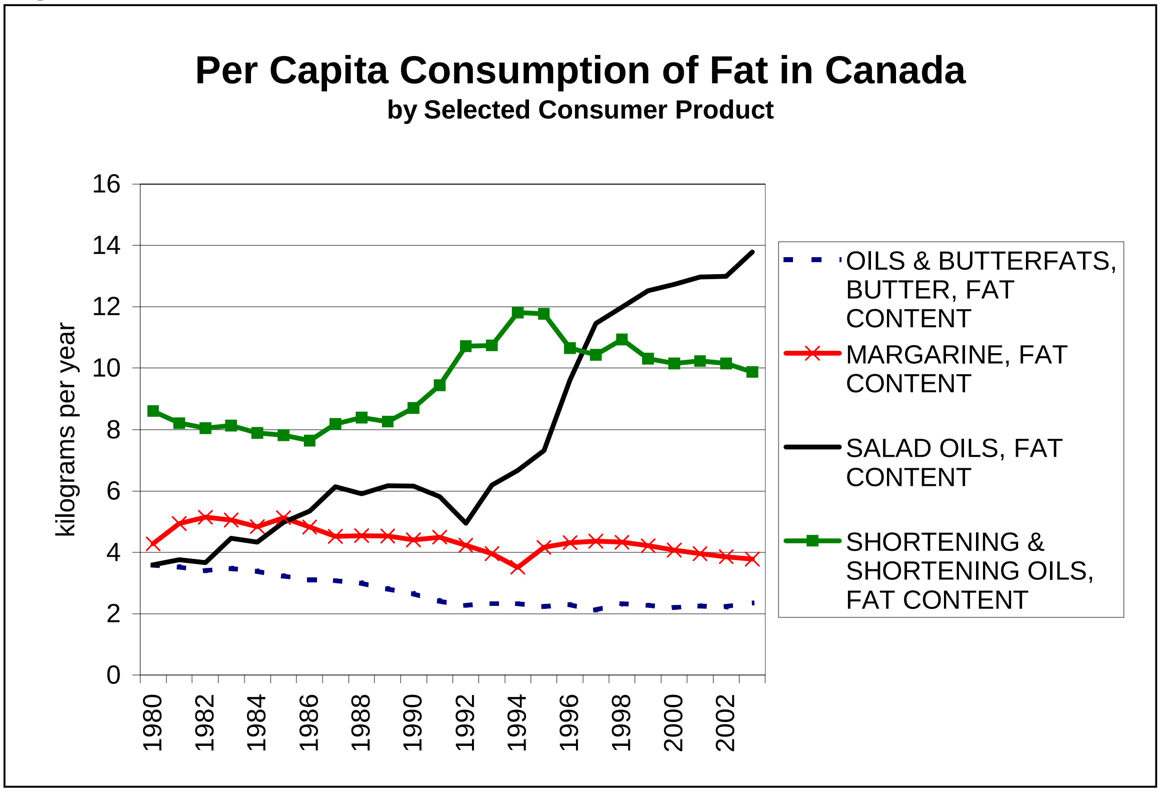
As well, the impacts from such a trans fat ban will differ for large versus small and medium sized companies. Efforts to alleviate this discrepancy are contained in the current legislation on mandatory trans fat labelling. The labelling regulation includes two implementation dates. Larger companies must comply with the legislation by December 2005, while smaller enterprises will have a grace period of two years. It is anticipated that any ban on trans fats is likely to follow a similar differential timeline.

a. Benchmarking Data

i. Consumer Sector

Consumers ingest TFA's from a variety of different sources: Processed foods, oils, butters and spreads, potato chips and french fries. To understand how ingestion patterns have changed over the last two decades, the following Figure presents per capita consumption of several oil-based consumer products.

Figure 4



Source: CansimII. Matrix: 3475 – Food Consumption in Canada (Part I and II). Table: 20011. Series: V108904, V108916, V108928, V108940.

As can be seen, the consumption of salad dressings spiked up throughout the 1990's, as consumers moved away from products they deemed "unhealthy". Correspondingly, oils, butters, fats and margarines faced a steadily declining demand throughout the twenty years presented in Figure 4. Shortenings faced a similar decline, likely for the same reason, but only after consumption peaked during the mid-1990s.

ii. Retail Sector

The retail sector has changed over the past two decades. While health concerns have come to the fore, convenience and time saving characteristics are factors that are in demand when it comes to food products and food service. Like most people in the developed world, Canadians now rely on restaurant meals to a much greater degree than they did in the past. As well, prepared foods eaten in-home are a more significant portion of the meals eaten in Canadian homes. Lifestyles have changed. With more two-income families, single-parent families, increased commuting times, and an abundance of family commitments to partake in, scheduling sit-down meals has become more difficult. Convenience has become an important attribute when it comes to meal preparation and consumption. With a greater reliance on restaurant meals and prepared foods, Canadians are less likely to be fully aware of the ingredients in their food. Given that fast-food meals tend to be higher in saturated fats and trans fats and Lifestyle changes are leading to higher levels of consumption of foods that promote “bad” cholesterol.

A small survey conducted for this study revealed that grocery store prices for most items labelled “trans-fat free” are the same as regularly labelled products. It appears that people in Calgary are willing to pay one-tenth of one cent more per unit of potato chips, margarine and cooking oil to purchase a “TFA-Free” product. Salad dressing shows a much greater difference across (western) Canada. Shoppers pay 3 to 4 tenths of a cent more for “TFA-free” salad dressing. However, this may be more a factor of brand loyalty or packaging size than any other factor.

Table 4

Percent Difference in Price by Location

Trans-fat price premium / regular price

Item	Calgary	Lethbridge	Ottawa	Unit
Crackers (fish shaped)	0%	0%	-9%	per gram
Muffins (fresh baked)*	0%	0%	0%	per gram
Packaged Cookies**	0%	0%	0%	per gram
Frozen French Fries	0%	0%	18%	per gram
Potato Chips	7%	0%	142%	per gram
Bucket Margarine (canola)	14%	0%	39%	per gram
Cooking Oil (canola)	18%	-14%	6%	per ml
Salad Dressing (french)***	44%	75%	65%	per ml

* Freshed baked items at Safeway are made with lard or animal-derived shortening.
** No packaged cookies were found to be "transfat-free".
*** All Kraft salad dressings are TFA-free.
No "transfat-free" brick margarine items were found.
Brand identiy and package size are likely the leading factors in price differences.

Source: ECONEX Consulting (See Appendix 2 for methodology and further results).

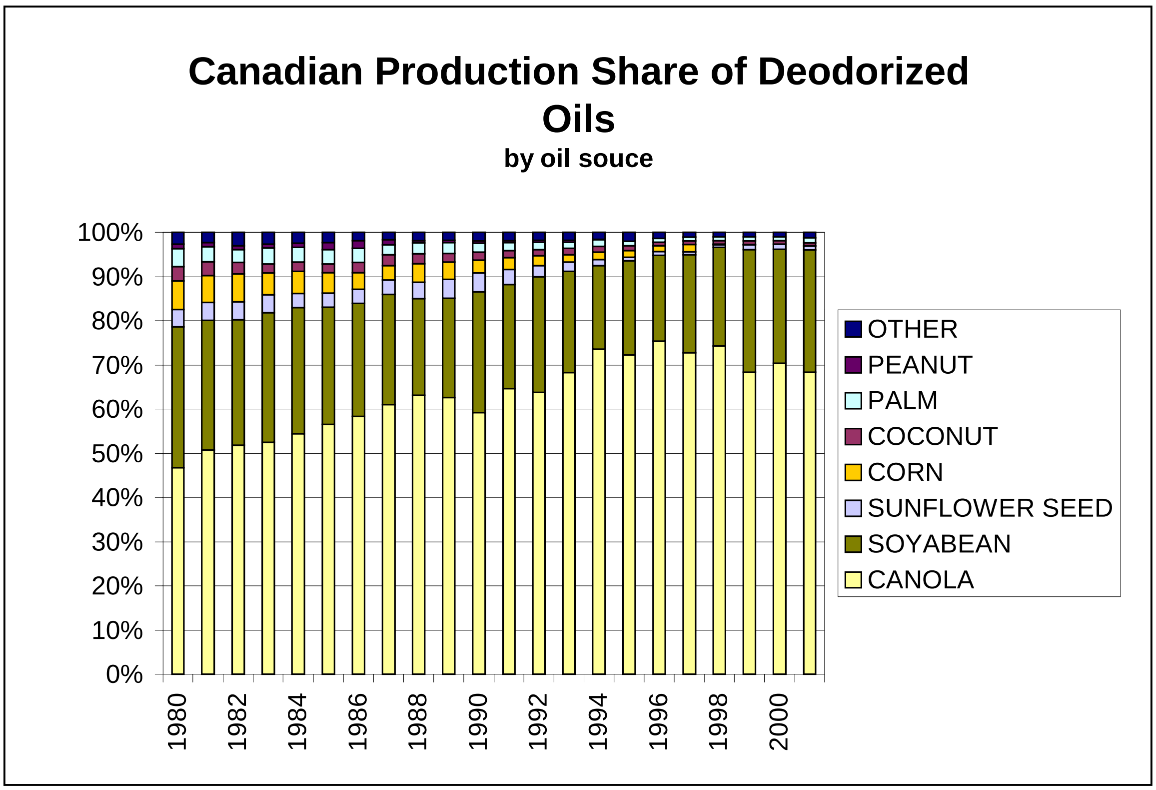
Given the small difference in pricing regarding “trans-fat free” labelling, it is likely that this product characteristic is not being fully realized by marketers or consumers. However, it is more likely that marketers have made a wholesale move toward products that are “trans-fat free”, like Kraft Foods Canada Ltd. In that case it is difficult to get a proper value on such a label because all products with similar branding are similarly priced.

iii. Food Processing Sector

Cost savings, mouth-feel, flavouring and ease of preparation can be enhanced with the use of fats in preparing meals. These are also factors leading to profitability in the food-processing sector. As a result, food processors, especially those producing prepared meals are inclined to use fats in their manufacturing processes. Give high heat, even mono-saturated fats can produce TFA's

The following Figure shows the share of oils used in the production of margarine oil, shortening oil, and salad oil. These data do not include oils derived from olives.

Figure 5



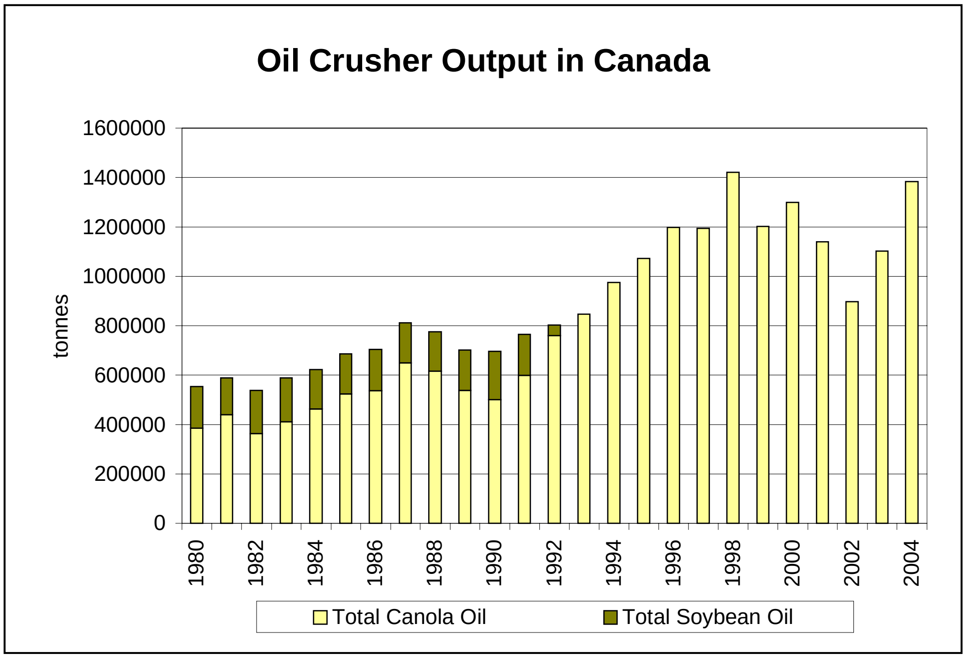
Source: CansimII. Matrix: 2121 – Oils and Fats. Table: 3030012. Series: V7515, V7516, V7517, V7519.

Oils other than canola are usually crushed in other countries and then shipped in by bulk container. While some soybean and sunflower crush occurs in Canada, the majority is imported. Note that the share of peanut, palm and coconut oil has been declining throughout the past twenty years. This is the result of consumer preference for healthier oils and increased canola seed production. Acquisition price also plays a role.

iv. Seed Crushing Sector

Oil output follows oilseed production. As oilseed crop production fluctuates so does oil production. As canola acreage rose during the 1990's, canola oil production expanded in a similar fashion.

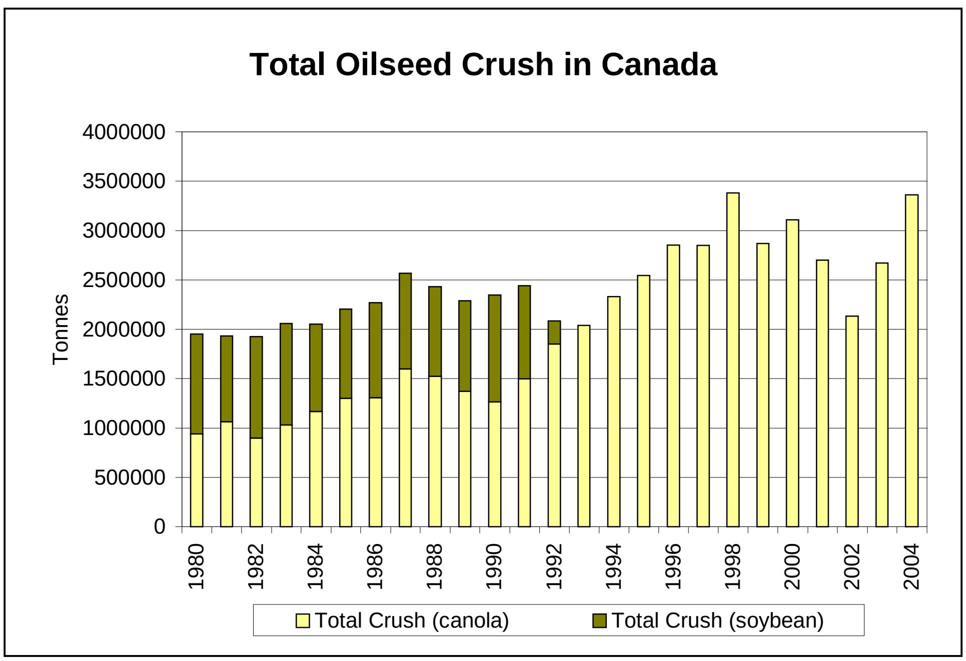
Figure 6



Note: Soybean data could not be reported after 1992 due to confidentiality issues.
Source: CansimII. Matrix: 3404 – Reports of Crushing Operations. Table: 10005. Series: V1459122, V1459124.
See also: *Profile of the Canadian Oilseeds Sector (Part 1 and 2)*. Market Analysis Division, AAFC.
<http://www.agr.gc.ca/mad-dam/e/bulletine/v17e/v17n13_e.htm>

Oilseed crushing operations have expanded significantly over the past two decades. Canola and soybean crushing volumes are outlined in the Figure below.

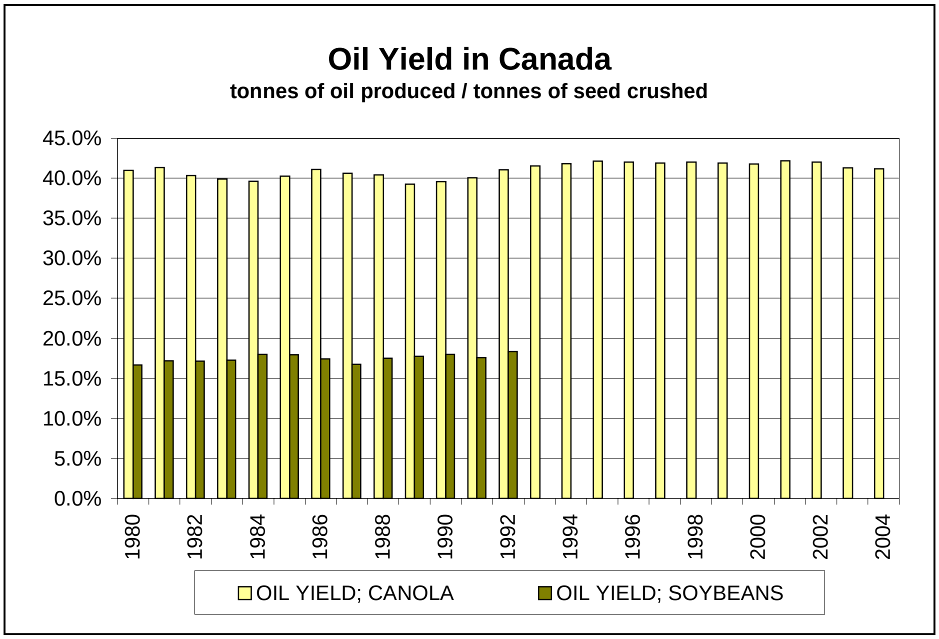
Figure 7



Note: Soybean data could not be reported after 1992 due to confidentiality issues.
Source: CansimII. Matrix: 3404 – Reports of Crushing Operations. Table: 10005. Series: V383414, V383417.

Crushing volumes were reduced during 2001 to 2003. During this period, reduced levels of oilseed production prompted crushers to reduce output. The oilseed shortage was primarily the result of the situation in the canola market, where limited acreage and lower yields during the 2001 and 2002 growing seasons were substantially below normal levels.

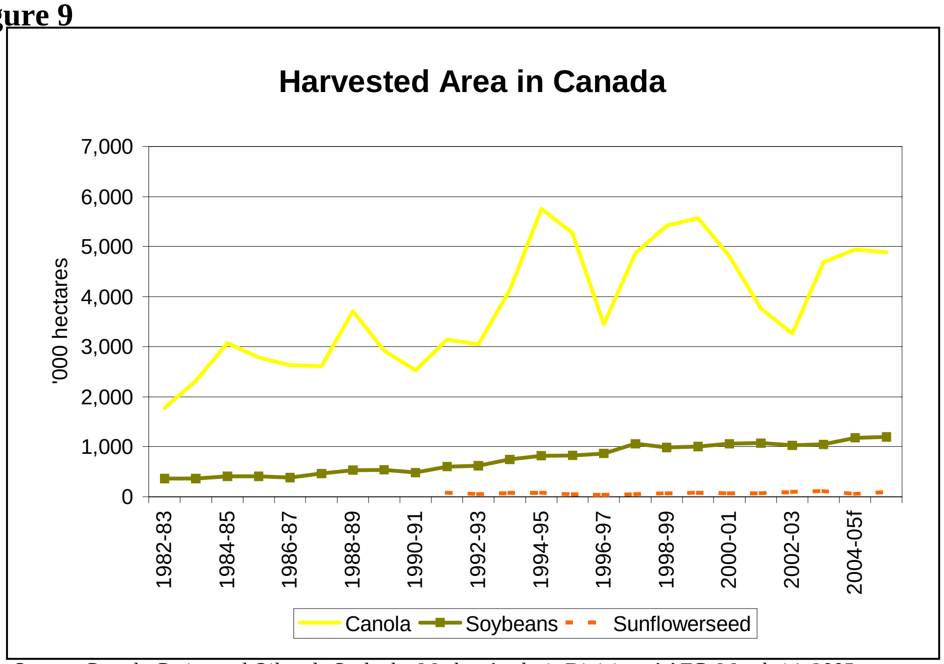
Figure 8



Note: Soybean data could not be reported after 1992 due to confidentiality issues.
Source: CansimII. Matrix: 3404 – Reports of Crushing Operations. Table: 10005. Series: V1459122, V1459124; V383414, V383417. ECONEX Consulting calculation

v. <u>Farm Sector</u>

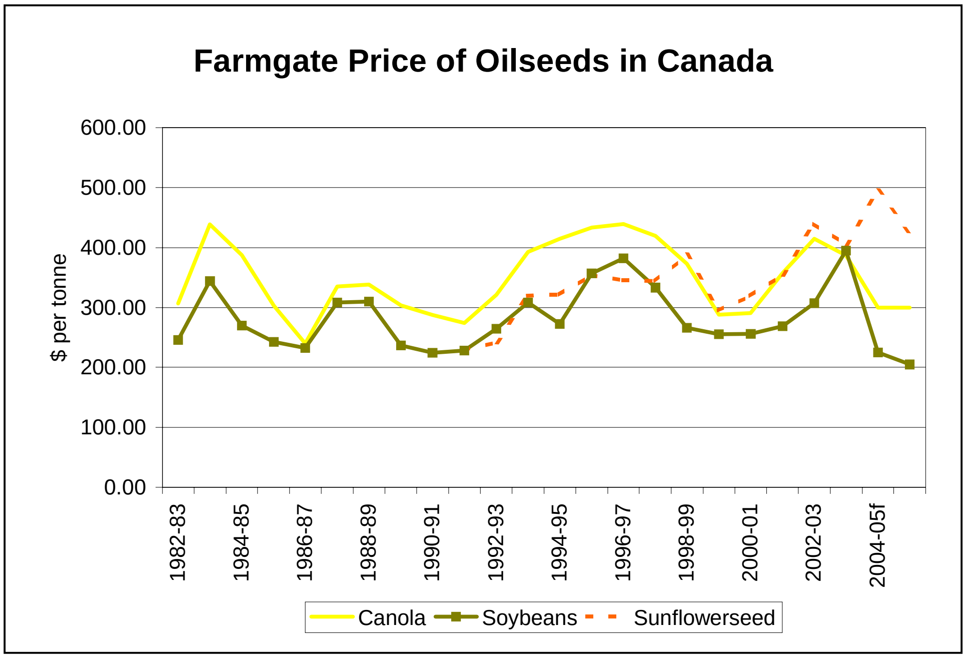
Figure 9



Source: Canada Grains and Oilseeds Outlook. Market Analysis Division, AAFC. March 14, 2005. <http://www.agr.gc.ca/mad-dam/e/sd1e/2005e/mar2005_e.htm>

Given that the farm sector approaches a perfectly competitive market structure, crop producers are compelled to take the world price of the commodities they produce, less transportation. Farmers can adjust to market conditions by changing the crops they produce. When oilseed prices are low they are more likely to produce less of those crops, when prices rebound, farmers will increase the amount of the crops in question.

Figure 10



Source: Canada Grains and Oilseeds Outlook. Market Analysis Division, AAFC. March 14, 2005. <http://www.agr.gc.ca/mad-dam/e/sd1e/2005e/mar2005_e.htm>

Canadian farmers produce crops for the world market. Only during years of extreme weather will imports of oilseeds expand beyond a very small amount.

Figure 11

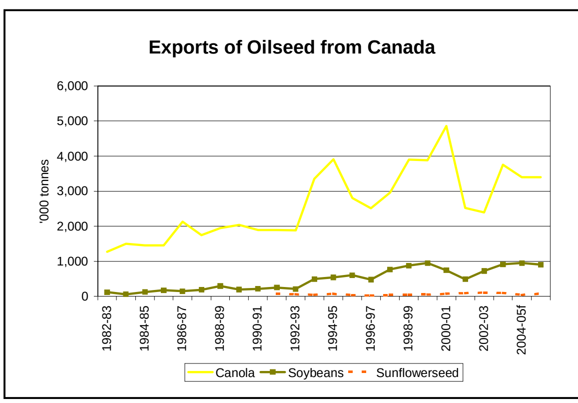
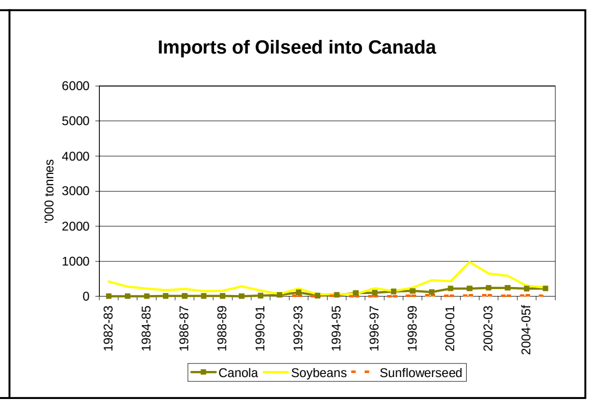


Figure 12



Source: Canada Grains and Oilseeds Outlook. Market Analysis Division, AAFC. March 14, 2005. <http://www.agr.gc.ca/mad-dam/e/sd1e/2005e/mar2005_e.htm>

vi. World Markets

Data for this section is shown in Appendix 5. Given the number of oils available for human consumption, and the volume of global production, it is anticipated that Canadian oilseed production will not impact the world oilseed complex. As such, it would be very unusual for a change in the Canadian market, like the ban on TFA's in Canada now being proposed, to have a significant impact on world markets. Rather, the size and fluidity of the world oilseed complex makes it more difficult for food wholesalers and retailers to charge a premium for canola oil, soybean oil, and products that contain them; unless these products can be differentiated in the minds of consumers. The only price impacts for oilseed producers are likely to be associated with soybeans in Ontario, where the industry occasionally switches from an export basis to an import basis for part of season. Under these conditions a reduction in the volume of soybean crush could have a small negative impact on the farm price of soybeans, as the occasions that prices reflect an import basis would be even less frequent.

b. Literature Review

i. Consumer Awareness, Willingness to Pay, and Acceptance

Beside the rapidly growing market, the possible price premium this industry offers is appealing to private companies, who are looking to invest into functional food development. For example, probiotic yogurt sells at one-third to two thirds higher price than regular yogurt, and mineral stimulated sport drinks sell at prices of three and a half times higher then conventional soft drinks in the United Kingdom (UK) (Winkler, 1996). Although research increases the cost of production, these elevated prices can still generate economic rent for its producers. In case of elevated Conjugated Linoleic Acid (CLA) milk levels, it is shown that even the farmers can increase their profits because of the price premiums consumers are willing to pay (Maynard and Franklin, 2003).

The most crucial question related to the functional food market is the consumers' attitude toward such products. Many economic studies exist on this aspect of the functional food market. Recently a research group released some studies based on a Canada-wide telephone survey of over 1000 households (Laure et al, 2002, West et al 2001, 2004). The survey serves many different purposes. Firstly, they examine the Canadian consumers' general knowledge of the relation between nutrition in food and health. They also measure their valuation of functional characteristics and attitude toward legislation. The survey also considers the average consumer's general attitude and knowledge about genetic modification as well as their feelings towards the labelling system. Most consumers are aware of the connection between nutrition in food and health. In some cases consumers are WTP price premium for healthier products (in some cases as much as 86%). Over 44% of the consumers are skeptical of the validity of the nutrition information on food labels. Very few Canadians have proper information about GM products in general; depending on the province 1.3-8% of the respondents answered the related questions correctly. The majority of consumers (54%) are discounting GM products and a small proportion (13%) are considered to be anti GM. Regardless of the negative attitude toward genetic modification the majority of consumers would purchase GM product if they contained some additional health benefit. Interestingly the survey showed consumers are more accepting of genetic modification in plants than animals and also value the functional properties higher in plants.

Burton and Pearse (2002), completed a survey among the Australian consumers to experiment with the consumers' attitude toward first and second generation food products. Although their survey did not use as big a sample as the Canadian study, they used repeated experiments and combined telephone surveys with mail back surveys. Their result showed that a much higher proportion of Australian consumers had a negative attitude toward genetic modification. 30% of the respondents said they were not willing to purchase GM foods regardless of the lower price or health benefits. While showed a willingness to pay (WTP) price premiums for GM products with value-added health characteristic. A significant proportion of the population was prepared to pay less for GM foods.

Schmidt (2000) in the "Consumers Response to functional foods in the 21^{st} century" examined the US consumers' behaviour by a widely held telephone survey and focus group discussions. The study focused on eating habits rather than consumers WTP. The focus group discussions were divided into two groups; motivated and unmotivated, based on how much health and nutrition play in their food purchases. During the two years of experiments they found the number of people who were already eating functional food increased by 7%. The survey found that consumers' food consumption was changing, replacing harmful ingredients (e.g. fat) with healthier ingredients. Schmidt also studied the flow of information between the consumer and producer and how much the consumer knows about products with health benefits.

Veeman's (2001) study addressed functional food legislation delays, the unknown market acceptance and size. The study's main focus was to compare and contrast different countries' regulations for the functional food and novel food industry. This report also emphasized the problem of value-added health products as drugs or as foods. As consumer interest grows towards functional food, government agencies started to examine the industry. The National Institute of Nutrition was responsible to conduct research in Canada to assess the consumer's attitude and knowledge about functional food and nutraceuticals (2000). This study was divided into two sections; (1) a qualitative section which obtained information from twelve focus groups, (2) a quantitative section which obtained information from a national wide survey of one thousand and three participants. The survey structure and questionnaire was harmonized with the IFIC's earlier survey, (documented by Schmidt 2000) making it easier to compare results from Canada and the US. The survey found the Canadian consumers were interested in food items with health benefit, for example, 88% of the recipient wanted to learn more about functional foods. At the same time, actual knowledge was very limited toward these food items. The research also states that health-care professionals, the media and the government are the most trusted means of relaying product information to consumers. The study asked consumers about the preferred terminology and found that 61% of the respondents liked the term functional food. The study tried to address the potential market segments, and not surprisingly, found that men and the younger generation were the least interested, middle aged and older men, as well as females paid more attention to the topic.

(See appendix 3 to review a tabular version of this part of the literature review.)

ii. Trans Fats and Health Problems

Food lipids (fatty acids) and cholesterol play an important role in the functioning of the human body. Fats are a major energy source (9 kcal per gram versus 4 kcal from proteins or carbohydrates), provide insulation, regulate physiological processes and allow the absorption of key vitamins like A, D E and K (Akoh and Min, 2002). Even cholesterol is essential for life and represents about 0.2% of body weight, stored mostly in the nervous system and one-third is stored in the muscles. "Cholesterol is the parent substance for Vitamin D2, bile acids, adrenocorital hormones and sex hormones" (Akoh and Min, 2002, p 543).

Besides their importance, food lipids can also impose risks to the body by elevating total cholesterol levels and worsening the low and high lipoprotein ratio. If the cholesterol level exceeds the desirable level in the blood, it is deposited into arteries (called plaque) narrowing them; this is called atherosclerosis and can lead to heart attacks, strokes or sudden death (Harvard School of Public Health, 2004). Cholesterol is created in the liver with its carrying units: lipoproteins. Low–density lipoproteins (LDL) transport cholesterol from the liver to the rest of the body and high-density lipoproteins (HDL) are responsible for the elimination of excess cholesterol in the blood and its transportation back to the liver (Harvard School of Public Health, 2004). That is why HDL is called "good" cholesterol and LDL is called "bad cholesterol".

Trans Fat and Chronic Diseases

Trans fatty acid content and form can vary in food items. Trans fatty acid or trans fat is an unsaturated fatty (mono or polyunsaturated) acid, which contains trans double bonds between carbon atoms (Expert Panel: Allison et al, 1995). Although trans fats naturally exist in different meats and dairy products, the main source in the human diet is hydrogenated vegetable oil. During hydrogenization some "cis" (single bond between carbon atoms) create an additional bond with the addition of hydrogen making the product thermodynamically more stable. The proportion of the trans content in hydrogenated vegetable oil depends on temperature and the type of catalyst used in the process. Theoretically the limit is 75%, but 50% is the most that is reached in commercial vegetable oils (when nickel used as the catalyst in soybean oil) (Expert Panel: Allison et al, 1995).

The connection between food lipid consumption and cholesterol levels has been under experiment for four decades. First, in 1957 Ahrens et al reported the relationship between fat intake, cholesterol level and coronary heart disease. This discovery was followed by many experiments in the 1960's, when scientists (Keys et al, 1965, Hegsted et al 1965) found the correlation between saturated fatty acids (SFA) and increased cholesterol levels and therefore cardiovascular disease. The finding prompted consumers to consume less animal fats and more vegetable oils. As scientist continued to research the relationship between oils and cholesterol level they found that not every vegetable oil has the same effect on blood cholesterol. Groundy and Vega (1988) discovered that some vegetable oils, like palm oil, that have high levels of saturated fatty acid have the same undesirable effect as animal fat. Later in the 1980's it was discovered that the cholesterol effect is not the same for different unsaturated fatty acids, these being monounsaturated fatty acid (MUFA), and polyunsaturated fatty acid (PUFA). While

PUFAs lower Total Cholesterol (TC) levels it was believed that MUFAs had a neutral effect (Vega et al 1982, Kuusi et al 1985). From the 1980's scientists started to examine the effects of food lipids, not just on total cholesterol but on LDL (bad cholesterol) and HDL (good cholesterol) and their ratios. This lead to the discovery that MUFAs are actually better then PUFAs because they only lower LDL (bad cholesterol), while not lowering HDL (good cholesterol).

Summary of the effect of different fats on cholesterol are found in Table 5:

Table 5 – Dietary Fats and Cholesterol

Type of Fat	Main Source	State at Room Temperature	Effect on Cholesterol Levels
Monounsaturated (MUFA)	Olives; olive oil, canola oil, peanut oil; cashews, almonds, peanuts, and most other nuts; avocados	Liquid	Lowers LDL; raises HDL
Polyunsaturated (PUFA)	Corn, soybean, safflower, and cottonseed oils; fish	Liquid	Lowers LDL; raises HDL[1]
Saturated (SFA)	Whole milk, butter, cheese, and ice cream; red meat; chocolate; coconuts, coconut milk, and coconut oil	Solid	Raises both LDL and HDL
Trans fat (TFA)	Most margarines; vegetable shortening; partially hydrogenated vegetable oil; deep-fried	Solid or semi-solid	Raises LDL, lower HDL

Source: Harvard School of Public Health, 2004, <http://www.hsph.harvard.edu/nutritionsource/fats.html>

Recently, health research has focused on trans fatty acids and found the same correlation, or an even more significant correlation than with saturated fat (Ross et al 2002). The problem with trans fatty acids (TFA) is that while SFA elevate both the LDL and HDL levels, TFA elevates the LDL (bad cholesterol) and at the same time reduces the HDL (good cholesterol) levels, therefore worsens the LDL/HDL ratio (Muller et al 1998, Sundam et al 2003).

There is a lot of scientific evidence that trans fatty acids have an adverse effect on human health, especially regarding cardiovascular diseases. The most direct evidence was shown in epidemiological studies (Siguel and Lerman, 1993, Troisi et al 1992, Willet et al 1993), where scientists examined population segments and their eating habits and proved that there is a statistical correlation between certain eating habits and the presence of chronic diseases. One of the most extensive epidemiological reports studied over eighty thousand women for 14 years and found that for every 2% of energy intake from trans fat increased the relative risk of coronary heart disease by 1.93% (Hu et al, 2004). A similar correlation was found in another cohort study that studied over forty thousand men and concluded that trans fatty acids are directly correlated to the risk of myocardial infarction (Ascherio, 1996). Besides the elevated cholesterol levels, there are some other health risks related to trans fatty acid consumption. Ip and Clemet claim in "Trans fatty acids and cancer" that they found evidence that trans fat increased the risk of cancer (1996).

As more and more scientific evidence became known the Federal Drug Administration (FDA) requested a report on the trans fatty acid intake. The Food and Nutrition Board prepared a comprehensive report and collected the results from eleven controlled feed trials, seven free-living trials, as well as the results of thirteen epidemiological studies (Institute of Medicine, 2002). The report concluded that there are no safe levels of trans fatty acid intake and therefore recommended the FDA to create a mandatory labelling system for trans fats.

Currently, there is no obligation in Canada or in the US to show trans fat content on labels. However, the emerging scientific evidence and consumers' demand has lead to legislation proposals in Canada and the United States. By January 2006 trans fat content must be shown on all food labels in the US, if the trans fat content is greater than 0.5g per serving (Federal Drug and Food Administration, 1999). Canada's proposed regulation is stiffer than the US, stating all trans fats content must be labelled, no matter how small the amount (Health Canada, 2003). The Canadian regulation is expected to come into affect by December 2005 for large manufacturers and January 2007 for small manufacturers.

Trans Fat Content in Oils and Foods

While the US Food and Drug Administration (FDA) has examined TFA consumption and TFA content in the American diet (FDA Consumer magazine, 2003), there have also been several independent studies. More and more scientists started to analyze the trans content of common food items starting in the mid-1980s. Some of these studies specifically examined trans content in fats and oils (Kochhar and Matsui 1984, Hyvönen et al, 1993). Others tested everyday food items like bread and cookies (Innis et al 1999, USDA 1995). The studies showed that the TFA content in foods has a wide variation, with significant differences between countries. In Finland the highest TFA in common margarine brands is only 17% (Hyöven 1993), in North America the TFA content reaches over thirty percent in the same type of margarines (USDA 1995, Innis et al, 1999).

Table 6 - Articles Analyzing Trans Fat Content [6]

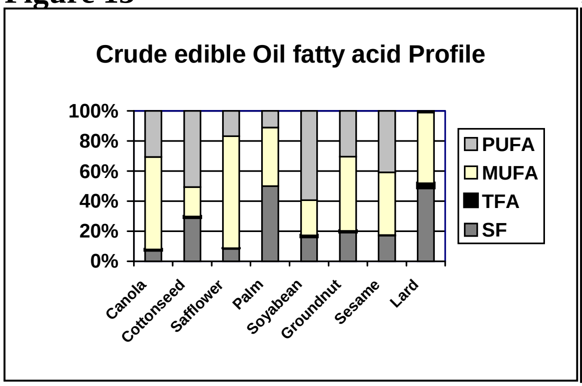
Author (year)	**Examined food items**	**Result**	**Location**
Kochhar and Matsui, 1984	The study examined 6 crude and 7 processed vegetable oils, 18 different types of margarines and 6 potato chips and butters.	While crude vegetable oils have almost no trans content, in processed form the content varies. Margarine trans fat content ranges between 21-42%.	UK
Hyvönen et al, 1993	Analyzed 24 commercial fats and oils including butter, tallow, soft, semi soft and hard margarines, vegetable oils (including corn, olive, reseed, soy and sunflower)	Margarines contain TFAs from 0%- 17% and hard margarines generally contain lower level TFA than soft and semi soft ones.	Finland
USDA, 1995	Examined 214 food items	Margarine TFA content has a wide variation between 7.91 to 31.86 %, on average it is 20.14%, lard and other animal fat TFA content is much lower and does not vary as much.	US
Innis et al, 1999	Analyzed over 200 food items, including 43 breads	The trans fat content has a wide variation among food items; therefore a sample diet may contain 1.5 g to 28.42 g of TFA on daily basis. Average calculation may be not possible due to lack of information. Margarine TFA content can reach up to 39.8%	Canada
Tavella et al 2000	Analyzed 46 fat and food items include butter, vegetable oils, bread, cookies and crackers.	Trans fatty acid proportion was very high in margarines (up to 31.84%) and	Argentina
List, 2004	Summarized previous studies and industry data's to provide a more comprehensive data source about TFA content.	The food TFA content is decreased by time probably under the pressure of the coming mandatory labelling.	US

Original crude vegetable oils contain little or no trans fatty acid (see Figure 13) but during refining, the process of hydrogenization alters their chemical structure and trans isomers are formed. The main reason for hydrogenization is to increase the stability of the product (therefore shelf life) and increasing the product's melting point making it more desirable for baking (List,

[6] Our table does not intend to list all the trans fat analyzing studies, rather it tries to give a general idea what kind of food items were examined, what has been found and how countries differ.

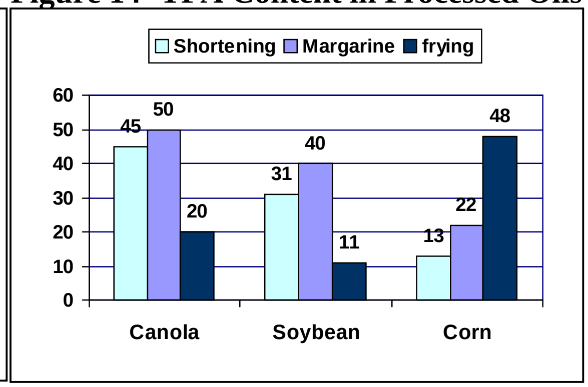
2004). Manufacturers favour the hydrogenization process because they enjoy cost savings, using oil as a less expensive lipid source. According to List there are trade-offs between saturated fat and trans fat in different food oils. For example, traditional canola oil has one of the lowest saturated fat levels of all vegetable oils, but has a trans fat content of 20% in frying oil and 50% in margarine and shortening. Similar trend can be seen in other vegetable oils like soybean and corn (see Figure 14). Some food processing companies tried to reduce trans fat content and create trans fat free or low trans fat products. To do this they replaced soy and canola oil with palm oil, which does not need hydrogenization, therefore has no trans fat. However, palm oil contains 50% saturated fat, which poses similar health concerns and therefore, not a desirable direction for manufacturers.

Figure 13



Source: List, 2004 & Canola Council information

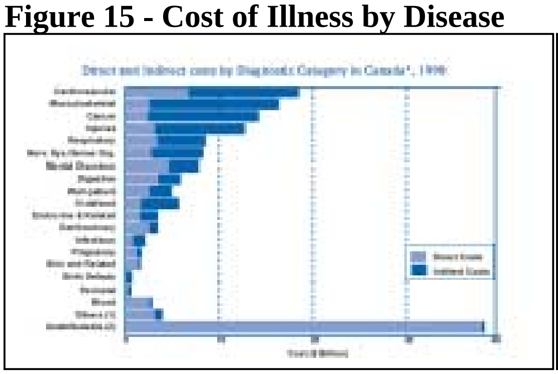
Figure 14 -TFA Content in Processed Oils



Source: List, 2004

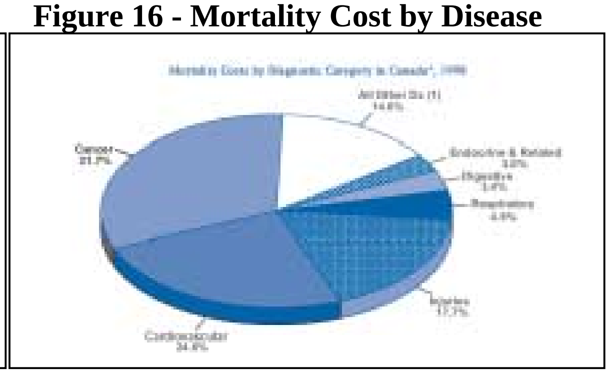
Cost of Cardiovascular Disease in Canada

Figure 15 - Cost of Illness by Disease



Source: Health Canada, Burden of illness in Canada, 1998

Figure 16 - Mortality Cost by Disease

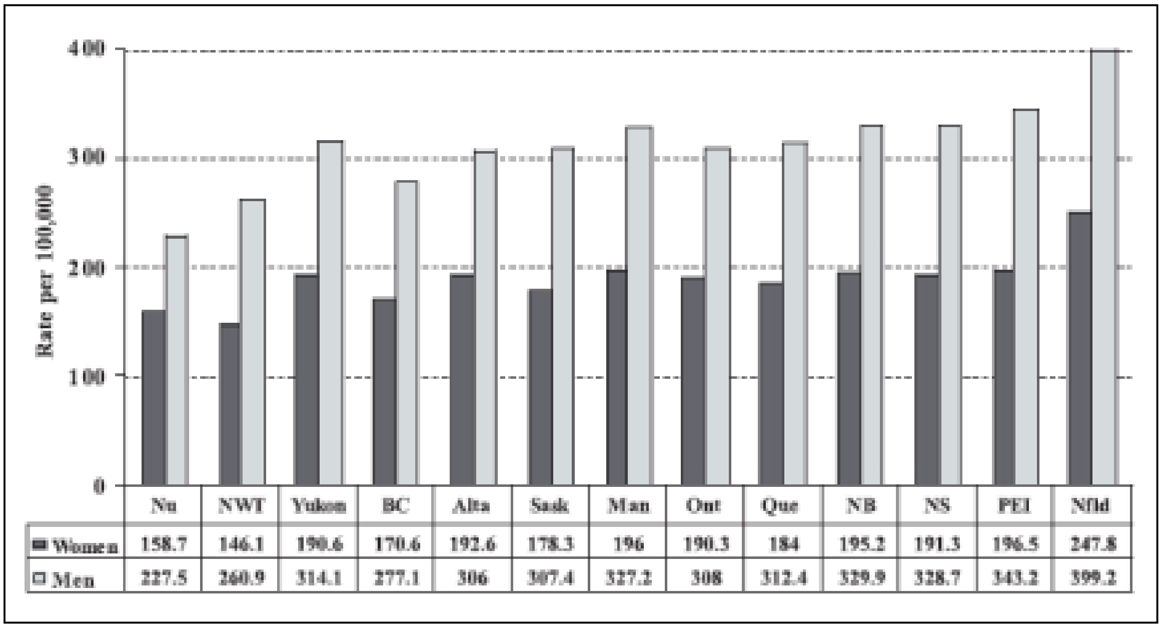


Source: Health Canada, Burden of illness in Canada, 1998

Treatment of cardiovascular related diseases is a major cost in the Canadian health budget. Cardiovascular related disease costs accounted for 11.6% (18,473 million CAD) of the total health costs, 8.1% of the direct costs and 15.4% of the total indirect costs in 1998, according to the Economic Burden of Illness in Canada report (Health Canada 1998). It comes even before musculoskeletal related costs and cancer treatment costs (see Figure 15). In addition, to its high costs it is also the leading cause of death in Canada (Health Canada, 2003). Ischemic heart disease accounted for 20% of the deaths in Canada (1999) and cardiovascular related deaths have increased since 1987 by 14% in women and 16% in men (Health Canada, 1998).

The mortality rate related to cardiovascular diseases is generally much higher for men than for women (See Figure 17). Women's mortality rate ranged between 158.7 and 247.8 per hundred thousand deaths, while men's cardiovascular related mortality rate is between 227.5 and 399.2 per hundred thousand deaths. It is also noticeable that the mortality rate is highest for both sexes in Newfoundland and it is the lowest in Nunavut and the Northwest Territories.

Figure 17 – Cardiovascular Disease Mortality by Gender and Province in Canada



	Nu	NWT	Yukon	BC	Alta	Sask	Man	Ont	Que	NB	NS	PEI	Nfld
Women	158.7	146.1	190.6	170.6	192.6	178.3	196	190.3	184	195.2	191.3	196.5	247.8
Men	227.5	260.9	314.1	277.1	306	307.4	327.2	308	312.4	329.9	328.7	343.2	399.2

Source: Health Canada, 2003, p 59

Trans Fat Consumption in Canada

Due to lack of official estimation and statistical data there is no accurate data available on daily TFA intake in Canada; therefore, we need to make a few estimations. First, we are going to review the TFA content in different foods and oils and estimate the average trans proportion by oil category. Then we will combine those results with the consumption of oil categories in order to have a general idea of how much trans fat is consumed in Canada.

To calculate the trans fat content by oil category we used one of the most detailed survey results available in North America (USDA, 1995). The USDA Nutrient Laboratory collected and measured 214 commonly sold oils and high oil content products in North America. The studies results are summarized in Table 7. Minimum, maximum and calculated average[7] values for the main oils categories are obtained. Illustrating salad oil TFA content is low to moderate (varies from 03% to 13.8%), margarines and shortening have high levels of TFA content on average (20.14%, and 19.84% respectively).

[7] Since there was no data available about the proportion in consumption of the product, the average was calculated by simply averaging all the products in each category.

Table 7 – Trans Fatty Acid Content by Product

	Min	Max	Average
Margarine	7.91%	31.86%	20.14%
Shortening	11.17%	34.05%	19.84%
Salad Oil	0.3%	13.8%	4.4%

Source: USDA

To estimate the total daily trans fat intake in Canada we combined the different fat consumption statistics with the previous estimation of trans fat content by oil category. We combined the calculated trans fat oil content from Table 7 with the Canadian consumption (Statistics Canada, 2001). The estimation is somewhat understated since total trans fat consumption per day is only 3.36 g on average while the FDA Consumer Magazine report estimates an average daily intake of 5.8 g per day in an average American adult's diet. However, this report does not contain any additional information about the numbers and/or any breakdowns of the estimations therefore, our calculations will use base, high, low and extreme low estimations.

iii. Alternatives to Trans Fat

Nexera Canola (Non-Trans Fat Vegetable Oil)

Natreon canola oil is made from Nexera canola seed without hydrogenation and is virtually trans fat free Natreon has higher levels of Oleic acid and lower levels of linolenic acid than conventional canola oil. This new fatty acid profile has made it possible for the oil to have a very high degree of stability, preventing the need for hydrogenation. Linolenic acid is an omega 3 fatty acid or "good fat" (polyunsaturated fat) with a positive effect on human health. Conventional canola oil is not stable on its own, so hydrogenization is needed, which is the process of turning fats into trans fat, which in turn increases LDL (bad cholesterol) and decreases HDL (good cholesterol), and is known to increase the risk of atherosclerosis and coronary heart disease.

Dow Agroscience Inc in Canada developed Nexera canola seed. The seed variety belongs to "Clearfield System" that provides herbicide tolerance to farmers, and at the same time is the result of mutagenic breeding, and therefore can be classed as a non-GM variety. The Nexera canola varieties have been grown in Western Canada since 1997, and are the only seed variety used to make Natreon canola oil. Natreon canola oil is only sold to food processing companies in Canada. It is not sold on supermarket shelves directly to consumers at this time, except in Japan, though it has been widely accepted by food processors and restaurants. For example, the Earls restaurant chain only uses Natreon canola oil (De Kock 2004). Company sources indicate that yield and profit margins for farmers compete with current elite varieties. Dow Agroscience and grain partners use identity preservation to assure that crops meet their specifications (Dow Agroscience, 2004).

Table 8

2004 Manitoba Crop Insurance Yield Information (in bu./acre)

Variety	Provincial average	Risk area 12 RR valley	Risk Area 7 Birtle	Risk Area 5 Treherne/Swan Lake	Risk Area 4 Central Manitoba	Risk Area 3 Virden/Miniota	Risk Area 9 Dauphin/Grandview/St.Rose
Nex 824 CL	**31**	35	19	35	30	27	24
Nex 830 CL	**37**	40					
Invigor 5070	**38**	40	29	36	41	27	40
Invigor 2663	**36**	39	21	35	37	30	40
46A76	**27**	31	16	37	28	24	29
46A65	**28**	28		36	33		19
DKL 34-55	**31**	33	18	36	31	27	28
45H21	**35**	35	24	37	36	31	36
IMC 109	**28**	33	12*	28	29	25*	28
AVERAGE YIELD	**32.9**	**34.8**	**19.4**	**35.2**	**34.5**	**27.3**	**34.9**

According to company representatives the trans fat free canola represents approximately 10% of the harvested canola seeds in Canada (Zacharias, 2005). The main market of Dow Agroscience is Japan, but the company also sells less then 1% of their Natreon Canola oil in Canada.

Other Novel Foods

Besides Nexera, canola many other companies in Canada and the US are experimenting with fatty acid profile changes in different crops (Health Canada, 2004). Beside Dow Agrosciences, Cargill Limited has developed a low-linolenic canola oil from InterMountain Canola (IMC), which is trans fat free. The main purposes of this research are: to reduce saturated fat content; to increase mono or polysaturated fat content; to create oils with greater frying stability; (e.g., high Oleic, low linoleic soy oil, and high sterene oils. Styrene is a SFA, perhaps less harmful than Palmatic acid). The new upcoming obligatory trans-fat labelling system in the US creates the incentive for companies to create varieties that have higher stability to reduce the need for hydrogenization. (See Appendix A4)

Finally, according to Nutriblend "…in February Germany's Bayer CropScience announced an agreement with private agro firm Cargill to bring a high oleic rapeseed oil, that will not require hydrogenation, to market by 2007. They join Dow AgroSciences, Bunge, ADM and DuPont that have all launched their various brands of zero or low trans oil, in the battle for market share as food makers undergo the investment in new technologies and new oil ingredients."
<http://www.foodnavigator.com/news/ng.asp?n=59250&m=1FNE407&c=qjhjvvuhxnidjin>

iv. Studies Undertaken in Other Countries

<u>The Influence of Trans Fatty Acids on Health (Fourth Edition)</u>. Danish Nutrition Council. 2003.

Legislation in Denmark

The rules regarding listing of ingredients are contained in the Labelling Order. Under this order all ingredients related to pre-packaged foodstuffs must have a list of all ingredients incorporated into the foodstuff at the production stage. Ingredients must appear in descending order by weight, meaning the ingredient in greatest amount is listed first. "Hydrogenated" must accompany any industrial produced oil on the food label. Only industrial produced trans fats must be included on nutritional labels, naturally occurring trans fats are not affected by this Order.

Starting June 1, 2003 the content of trans fatty acids in oil and fats must not exceed 2 grams per 100 grams of oil and fats. From June 1, 2003 until December 31, 2003 the oils and fats included in foodstuffs which contain other ingredients other than oils and fats which are produced in retail outlets, restaurants, bakeries, and other similar establishments may contain up to 5 grams of trans fat per 100 grams of oil and fats. Products that include trans fats at a level less than 1 gram per 100 grams of oil and fats can claim to be “trans fat free.”

EU Labelling

Nutritional labelling refers to energy, protein, carbohydrates, fat, fibre, sodium and vitamins and minerals. Nutritional labelling is voluntary unless a nutritional claim is used, then nutritional labelling is mandatory. A nutritional claim is any indication on the package, presentation and/or advertising that is liable to give consumers the impression that the food product contains special nutritional characteristics. If a nutritional claim is made regarding trans fat, then the label must include the percentage of trans fat per 100 grams of the food product. Demark cannot, on its own, change the rules for nutritional labelling in the EU, such a decision must come in the form of an EU Directive. This document states that an EU Directive regarding nutritional labelling will soon be established, but does not say when or how in the report.

Canada and the US

On January 1, 2003, Canada introduced a labelling of the content of trans fatty acids.

The US regulation states that trans fats will be labelled on conventional foods and dietary supplements effective January 1, 2006. The difference between the US regulatory approach and the Danish approach is that the US will leave it up to the consumer to decide if he/she will consume trans fats, where the Danish do not want to leave it up to the consumer to decide, but rather force reduction of trans fats at the industry level.

Dietary Intake

In the EU average mean daily intakes of trans fats from 14 different countries estimated in the TRANSFAIR study ranged from 1.2 to 6.7 grams per day and 1.7 to 4.1 grams per day among men and women. Intakes were lowest in the Mediterranean countries.

Health Effects

Controlled human intervention studies indicate a link between trans fat consumption and increased serum LDL cholesterol, increasing ones risk of CHD and decreasing HDL. Human intervention studies cannot prove that trans fats affect blood pressure and insulin sensitivity. Epidemiological evidence for the possible relationship between trans fat intake and elevated occurrences of cancers, type 2 diabetes, or allergies is weak. The intake of trans fatty acids has been shown to have a positive effect on cardiovascular risks. Currently there are no sure test methods to distinguish between naturally occurring trans fat and industrially produced trans fat through the hydrogenation process.

Rule to Include Trans Fatty Acids in Nutritional Labelling. Food and Drug Administration (FDA). Published in the US Federal Register on July 11, 2003.

Regulation

Previous regulation did not require that trans fat content be included on food and foodstuff labels. With this rule, the Food and Drug Administration (FDA) amended its regulations on nutrient labelling to require that trans fatty acids be declared on the nutritional label of conventional foods and dietary supplements. The rule requires that the information regarding trans fatty acids be placed on a separate line underneath the declaration of saturated fatty acids. This rule was intended to provide information to assist consumers in maintaining healthy dietary practices.

Economic Impact

The FDA examined the economic implications of the rule and concluded that it would have the greatest impact on a substantial number of small entities. This rule is anticipated to affect almost all manufacturers of packaged, labelled food sold in the United States (US). FDA calculated that this rule would increase the average cost to small business by roughly $12,000. Policy options for small business were; (1) exempt small business from this $12,000 payment, which was thought to be undesirable because the full benefit of the rule would not be realized, (2) provide a longer compliance period, FDA did comply with this option, setting the effective date of the rule to January 1, 2006, (3) provide an exemption for small business, this was deemed not desirable because the consumption of trans fatty acids would result in unforeseen consequences to the consumer, therefore it was decided that all foods must be labelled. FDA estimated that 10,300 small businesses would be affected by this rule. The total burden on small entities was estimated to be between $96 million and $184 million, or $9,300 to $17,900 per entity.

The rule was forecast to increase food costs for all consumers, although it is not expected to substantially affect productivity or economic growth. The rule does not mandate any changes to current export products.

III. Analysis:

In order to assess the impacts from a trans fat ban in Canada, both market impacts and social implications must be evaluated. An improvement would arise only if the market effects, including those that apply to industry as well as consumers, are less than the social improvements that arise from the ban. Industry impacts include the effect on all segments of the oil and fats supply chain, from consumer to farmer. The social / health implications are enumerated as health care savings, though this can be considered a proxy for the healthfulness of the Canadian population. The following sections outline these two broad effects using various scenarios.

a. Market Impacts

This section will focus on the private costs associated with implementing a mandatory trans fat ban in Canada. Four behavioural changes are presented in an effort to quantify the impacts on farmers, seed crushers, food processors, food providers (grocers and restaurants) and consumers. These actions are not mutually exclusive. Individuals and enterprises within certain segments of the oil and oilseed complex (both producers and users) will react to a trans fat ban in their own particular way. What is outlined here are some of the more likely responses and their impacts. These actions may include include:

1) Removal of all products containing trans fat;
2) Production and use of non-TFA oilseeds;
3) Use of alternative oils from offshore markets; and / or
4) Reformulation of oils and fats and use of alternate crushing processes.

i. Action 1

In many food products there are already examples of trans fat free products available in the market place as reported in Table 1. Stick margarine was not available in small survey of retail stores. S. Campbell (2005) estimates that these products are one to three years away from commercialization and that they make lack desired taste and melting properties.

Because it is difficult to determine the exact number of products that would need to be removed from sale, the following analysis focuses on stick margarine as an example of a product that would need to be removed from store shelves, restaurant menus and processor inventories until new products are developed.

Under this scenario, consumers would need to find alternatives to products like stick margarine. It is likely that consumers would shift toward butter and bucket margarine. Given that current Canadian consumers of stick margarine are assumed to be price-sensitive, it is anticipated that many of these "stick" consumers would shift toward the lowest priced alternative, namely bucket (tub) margarine. Even though bucket margarine may be the least expensive alternative, it is a substantial 0.061 cents per gram (60 cents per kilogram) more expensive than the stick form of the product. While this could represent a substantial percent increase in the cost of margarine, the increase in total annual cost per consumer will be very small, given the average per disappearance of all forms of margarine in just over 4 kg per year.

There is, however, a segment of “stick” user population that are not nearly as price sensitive. These are individuals who use stick margarine for baking, either for home use or for resale. These consumers would be more concerned with mouth-feel and flavouring. It is likely that they would switch to butter rather than bucket margarine.

Regardless, only a small portion of oil sales would be affected. Margarine comprises roughly 11.5% of total Canadian consumption (as seen in Table 1 on page 3) and industry sources[8] indicate that stick margarine has a market share of half of all margarine sales, the total amount of stick margarine that is sold in Canada totals 64,000 tonnes, or less than 1% of domestic oilseed production. While the grocer/restaurant and processor levels of the supply chain would need to adjust to the removal of these products, the farm sector is expected to be untouched from the price and sales impacts being felt further up the supply chain. The farm sector would be immune from such effects because a Canadian ban on trans fats and the potential for elimination of stick margarine from Canadian store shelves and processor pantries would not reduce world demand for canola or soybeans[9].

ii. Action 2

In order to meet demand for stable non -TFA frying oils there will be an increase in the amount of high oleic (HO) canola grown. To increase meet this need firms will contract with producers for more supply. Note that these products will not address the needs bakeries that use heavily hydrogenated fats in laminated bakery products, or the need for heavy duty frying oils. These products will have to rely on the use of traditional saturated vegetable and animal fats or the introduction of high stearic acid vegetable oils.

Farm-Level Effects:
Farmers will produce Non-TFA oilseed varieties when the profit / risk profile warrants a change to the crop rotation employed by the farmer.

To sign a contract to grow a HO canola a producer must expect a net return per acre equal to, or greater than, the expected net return from growing regular canola varieties. The incentive for the contracting companies will be to offer a premium just large enough to obtain the acreage needed. This would suggest that the additional revenue offered to producers will not significantly increase their bottom line.

Currently, the price premium being paid to producers of non-TFA varieties is $44 per tonne ($1.00 per bushel). However, the costs of seed and herbicide are slightly higher for non-TFA varieties and, according to some farmers, yields are slightly lower, especially in dry areas of the prairie region. This premium represents about 15% of the price of traditional varieties.

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[8] Discussions with officials from Dow Agroscience.

[9] This assumes that the decision in Canada to reduce trans fats would not stimulate other countries to follow suit.

Crusher Impact:
In order to overcome agronomic constraints and cost differences, crushers need to pay a price premium to induce sufficient numbers of producers to grow these crop varieties to ensure adequate supplies of non-TFA oils. According to industry sources, roughly 10% of canola seed produced in Canada is non-TFA variety. However, only 10% of that production is used in Canada. If the industry wanted to induce a larger acreage they may have to offer a larger premium to attract more producers.

If a ban were put in place, at least 65% of domestic disappearance (the current proportion used as fully or partially hydrogenated product) would need to be derived from non-TFA varieties of seed (See Table 9 & 10).

Table 9
Canadian Domestic Disappearance of Vegetable Oil by Hydrogenation Level & Type
Thousand Metric Tons

	Consumption	Refining Loss	Fully Hydrogenated	Partially Hydrogenated	Non Hydrogenated
Coconut	7.00	0.21	6.79	-	-
Canola	520.00	15.60	130.34	125.04	249.02
Cottonseed	30.00	3.00	7.57	5.96	13.47
Olive Oil	25.00	0.75	-	-	24.25
Palm	10.00	0.30	9.70	-	-
Soybean	395.00	7.90	149.73	213.21	24.16
Sunflower	20.00	1.60	-	3.50	14.90
Total Vegetable Oils	**1,007.00**	**29.36**	**304.13**	**347.71**	**325.80**

Source: Dow Agrosciences, publication date unknown

Table 10
Canadian Domestic Disappearance of Vegetable Oil by Destination, Level of Hydrogenation & Type
Thousand Metric Tons

	Manufacturing			Non-Manufacturing		
	Fully Hydrogenated	Partially Hydrogenated	Non Hydrogenated	Fully Hydrogenated	Partially Hydrogenated	Non Hydrogenated
Coconut	6.79	-	-	-	-	-
Canola	15.94	14.45	43.65	114.40	110.58	205.37
Cottonseed	1.23	4.78	9.92	6.35	1.18	3.54
Olive Oil	-	-	1.21	-	-	23.04
Palm	8.49	-	-	1.21	-	-
Soybean	69.99	108.41	18.64	79.74	104.81	5.52
Sunflower	-	3.22	9.66	-	0.28	5.24
Total Vegetable Oils	**102.44**	**130.86**	**83.09**	**201.70**	**216.85**	**242.71**

Source: Dow Agrosciences, publication date unknown
Note: Manufacturing is vegetable oil used in food processing or sold as part of a product.
Note: Non-Manufacturing is vegetable oil sold as vegetable oil to retail or foodservice.

So, the total non-TFA oil need after the ban would be:

1,000,000 tonnes * 65% = 650,000 tonnes of oil.

Adjust this amount to an oilseed equivalent:

650,000 tonnes / 0.4 conversion rate = 1.625MMT of oilseed.

Thus, the additional cost to oilseed crushers is:

1.625MMT * $44 per tonne [price premium] = $71.5 million.

This increase in total crusher cost would be reduced to the extent that yields could be improved relative to traditional varieties, or costs (seed and herbicide) could be reduced; or to the extent that producers would be willing to transfer acreage to non-TFA varieties with less than a $44 per tonne premium. However, it is more likely that producers would demand a price premium of $66 per tonne or higher, given the agronomic constraints and relative cost differences. The total impact would adjust accordingly.

Food Processor Impacts:
According to data in Table 10, the share of increased acquisition costs of non-TFA oil for food manufacturers is estimated to be:

233,000 tonnes of oil * 0.4 conversion rate = 582,200 tonnes of seed.

582,200 tonnes of seed * $44 per tonne = $35.63 million, which is 11 cents per kilogram of oil.

The crushers may charge a higher a higher premium for their HO oil products. If this is the case then the crushers and or technology owners will benefit while creating an offsetting increase in cost for the food processors.

Grocery / Restaurant Impacts:
Grocery stores and restaurants would also take a share in the increased cost of acquisition:

417,000 tonnes of oil * 0.4 conversion rate = 1,042,400 tonnes of seed.

1,042,400 tonnes of seed * $44 per tonne = $45.87 million.

Consumer Effect:
Note that the impact from a transition to non-TFA oilseeds from more traditional varieties is a direct cost increase to crushers, but this entire impact is likely to be passed through to Canadian consumers by way of food processors and retailers.

Note that the costs referred to in scenario 2 are annual costs. The proportion price impacts on low value fat products will be significant, however for most products where the fats content relatively low the proportional impact on cost and final product prices will be negligible. If we assume that the entire industry switches to HO canola, the cost to the industry would be $81 million per year. This amount, although somewhat conservative, works out to less than $3.00 per Capita per year or less that one cent per day.

Also, the impact on the margarine market would be similar, but its share of the annual cost increase would be 11.5% of the total, or $8.2 million.

iii. Action 3

Under this scenario, food processors would replace existing amounts of canola and soy oil in order to use a greater amount of oil from offshore sources. These alternate oils include palm, cottonseed, and coconut oils. Because these oils contain higher levels of saturated fats, there is not only an economic implication, but also a reduction in the health benefits that would attribute to Canadians from implementation of the ban on TFA's (see the next section of the analysis for details). This substitution would take place as a means of creating margarines and shortening.

Farm Level Effects:

Assumptions:
- Farmers are price takers.
- The global oilseed complex is vast.
- There are generally open markets in oils and oilseeds.

It is likely that farmers would not be materially affected by a move toward fats and oils from offshore sources. While more offshore oils would likely be used under this scenario, Canadian farmers would be able to export their current level of production at market prices.

Table 11

World Supply and Use for Oilseeds 1/

(Million Metric Tons)

Commodity	Output	Total Supply	Trade	Total Use 2/	Ending Stocks
Oilseeds					
2002/03	329.67	368.27	70.44	267.66	45.14
2003/04 (Est.)	336.38	381.52	66.68	278.77	42.3
2004/05 (Proj.)	386.51	428.81	72.77	299.26	62.43
Oilmeals					
2002/03	184.56	190.35	53.96	184.38	4.84
2003/04 (Est.)	190.63	195.47	58	189.84	4.58
2004/05 (Proj.)	203.84	208.41	59.68	201.54	4.86
Vegetable Oils					
2002/03	94.74	103.03	36.18	95.36	6.68
2003/04 (Est.)	100.98	107.66	37.67	99.38	6.82
2004/05 (Proj.)	106.82	113.64	39.39	105.63	7.09

1/ Aggregate of local marketing years with Brazil and Argentina on an Oct.-Sept. year.
2/ Crush only for oilseeds.

Source: USDA -- World Agricultural Outlook Board. "World Agriculture Supply & Demand Estimates Report." March 2005. <http://www.usda.gov/agency/oce/waob/wasde/wasde.htm>

Total global production of oilseeds is anticipated to be 386.51 million tonnes in the 2004-05 crop year (Table 11). Canadian production of canola, soybeans and sunflowerseeds is expected to total 10.83 million tonnes for the same year (Table12). It is not surprising that Canadian farmers cannot impact the world price. Small size of the Canadian market is even more apparent when consumption is considered. Canadians consume less that 1 million tonnes of vegetable oil out of a global total of 100 million tonnes, or 1% of the total. A shift of oil consumption patterns of less than 1% of the total is therefore very unlikely to have a discernable impact on the global price of oilseeds. In the case of canola, which relies on exports of seed each year, the producer price is equivalent to the global price less the cost of transporting the seed to its final destination.

Currently, palm, cottonseed and coconut oil make up 3.7% of the domestic disappearance in Canada. These oils could be used in place of, or as blends with, canola or soy oils to reduce trans fat in processed food products. However, to the extent that these oils contain saturated fats, the reduction in health impacts will be muted.

Table 12

Production, Trade and Stocks of Canadian Oilseeds
Thousand Tonnes

Grain and Crop Year	Production	Imports	Total Supply	Exports	Ending Stocks
		Canola			
2002-03	4,407	239	5,896	2,394	894
2003-04	6,771	243	7,908	3,754	612
2004-05f	7,728	220	8,560	3,400	1,500
		Soybeans			
2002-03	2,336	651	3,159	723	145
2003-04	2,268	587	3,000	913	140
2004-05f	3,048	300	3,488	950	425
		Sunflowerseeds			
2002-03	157	21	200	105	35
2003-04	150	16	201	96	25
2004-05f	54	25	104	40	5
		Total Oilseeds			
2002-03	6,900	911	9,255	3,222	1,074
2003-04	9,189	846	11,109	4,763	777
2004-05f	10,830	545	12,152	4,390	1,930

Source: AAFC. Market Analysis Division "Canada: Grain and Oilseeds Outlook". March 2005. <http://www.agr.gc.ca/mad-dam/e/sd1e/2005e/mar2005_e.htm#download>

Crusher Impact:
Canadian crushers might need to reduce output volumes since the imports of alternate oils would reduce dependence on Canadian-produced oils. However, crushers could just as easily continue to producer the same volume, but ship the excess to export markets.

Assuming a 5-fold increase in alternate oils from offshore and no expansion in export shipments of Canadian-made oils, crushers would reduce output by:

Current consumption of offshore oils: 37,000 tonnes of oil.
5-fold increase: 185.000 tonnes of oil.
Oilseed equivalent: 462,500 tonnes of oilseed.

This is not that significant a decline since current Canadian crushing volumes are now 4.6 MMT of seed.

Food Processors:
Processors would be impacted by the difference in acquisition prices multiplied by the increased use of offshore oils. Note that price differentials fluctuate significantly over time. Given the prices in Table 13, and adding 1.0 to 1.3 cents (US) per pound for transportation from port to prairie region, processors could expect to pay between -5.4 and 8.0 cents (US) per pound more to access supplies of offshore oils:

Table 13

Selected Prices of Edible Oils in North America

US cents per pound

	Canola Oil Prairie Region	Canola Oil US Midwest	Soybean Oil Decatur, Il	Coconut Oil New York, NY	Palm Oil US Ports	Cottonseed Oil Greenwood, MS
2001	26.17	18.86	16.46	24.15	15.73	15.41
2002	29.97	27.17	22.04	21.94	23.31	23.34
2003	31.31	27.20	29.62	24.05	31.76	36.73

Source: USDA, AAFC, and the Bank of Canada

Current us of offshore oil: 37,000 tonnes.
5-fold increase: 185,000 tonnes.

Multiplying by a range of price differences we arrive at a range of impacts:

185,000 tonnes * (-$119) = -$22.0 million.

185,000 tonnes * ($176) = $32.6 million.

Depending on the yield performance from one year to the next and from one part of the globe to another, and depending on the efficacy and efficiency of the transportation system, one could expect either of these two outcomes in any year. This is likely a wash.

Consumer (Grocery / Restaurant) Effect:
Increases in food processor costs are expected to be passed on to consumers. Given the oligopolistic structure of the market further up the supply chain, costs savings may be expected to flow to the consumer.

iv. Action 4

Food processors have already decided to reformulate and re-label existing food products to meet labelling requirements. As food crushers, and food processors, food manufactures reformulate products in response to a ban, these firms will have to incur additional costs to test and re-label their products. While no impact from these efforts will be seen on farm or at the grocery /

restaurant, oil crushers and food processors may see some increased costs. Likely they will pass these increased costs on to consumers.

There is little ability to estimate the amount of money that will be needed to make these one-time differences. This is because the number of products requiring testing, reformulation and re-labelling is indeterminate. The per product costs were evaluated in the US during its efforts to institute trans fat labelling:

Testing: $US200 per product
Reformulating: $US440,000 per product
Re-labelling: $US1100-2600 per product.

These are significant upfront costs that will likely mean that some of the businesses, particularly small ones, will not survive the transition. In assessing these impacts it is important to separate those costs associated with mandatory labelling, which is already law, and the additional costs that would be imposed by a subsequent trans fat ban. The timing for compliance would also affect these costs. If same firms are given a longer grace period, which they were granted in the labelling legislation, then they will have greater ability to develop new products and label them in one step rather than more expensive two step process where re-labelling would be required.

However, given the multinational ownership of many food processors in Canada, the reformulation costs that would be expended to meet the requirements under a trans fat ban may be subdued somewhat by technology transfers within larger companies that face similar trans fat bans in other jurisdictions.

v. The Bottom Line

Table 14

Industry Impacts Resulting from a Transfat Ban in Canada

	Scenario 1	*Scenario 2*	*Scenario 3*	*Scenario 4*
Farm Sector				
Crushing Sector		$71.5 million in increased acquisition costs		
Food Manufacturing Sector			Impact Range: from a Benefit of $22.0 million to a Cost of $32.6 milllion	Testing: $US 200 per product; Reformulation: $US440,000 per product; Re-labeling: $US1100-$US2600 per product.
Grocery / Restaurant Sector				
Consumer Sector				

After collecting data concerning all segments of the oil complex, reviewing much of the literature on trans fat bans, and conducting an analysis of the market impacts that would occur if a trans fat ban were to be implemented in Canada, it is clear that industry players associated with most of the affected products would not face significant economic adjustment, and that implications to the entire edible oil supply chain are relatively small in relation to the size of the industry. The analysis indicates that each segment of the industry may face different adjustment costs, but that the ban's effect on most products would be considered insignificant in relation to consumers, grocers, restaurants, food processors, oilseed crushers and farmers, as well as providers of ancillary services to these entities.

The relatively mild economic impact is the result of several factors related to market structure, and the fact that industry participants are already moving toward products with reduced trans fat content and must respond to labelling requirement. This is the result of proposed labelling legislation in Canadian and US that is compelling food manufacturers in North America to list the amount of manufactured trans fat that is contained in each product. The analysis also focuses on stick margarine because this is one product that has not yet been altered regarding reformulation or re-labelling, although even this product created modest impacts from the implementation of a ban. Although we were unable to quantify the impacts there is likely to be some impact in laminated bakery and products that use industrial frying oils because satisfactory non-hydrogenated substitutes for these products do not currently exist.

Small firms would face the largest per unit costs to reformulate and re-label their products to comply with a ban. These cost will be mitigated to some extent by the extra year small firms will have to comply with the labelling requirements.

As noted above, market structure played a major role in how products and industry segments reacted to establishment of a trans fat ban. Because the global oilseed complex is so vast, and Canada's role in it is relatively small, changes in Canadian regulations are not likely to have a significant impact on the global market. As for the domestic market structure, the perfectly competitive nature of farming, the oligopolistic tendencies of the crushing and processing sector and the atomistic character of the Canadian consumer sector skew the impact toward the farmer and the end-user. However, these economic players can limit the impacts they are subject to under a trans fat ban by existing from the market, either temporarily or, on a more permanent basis.

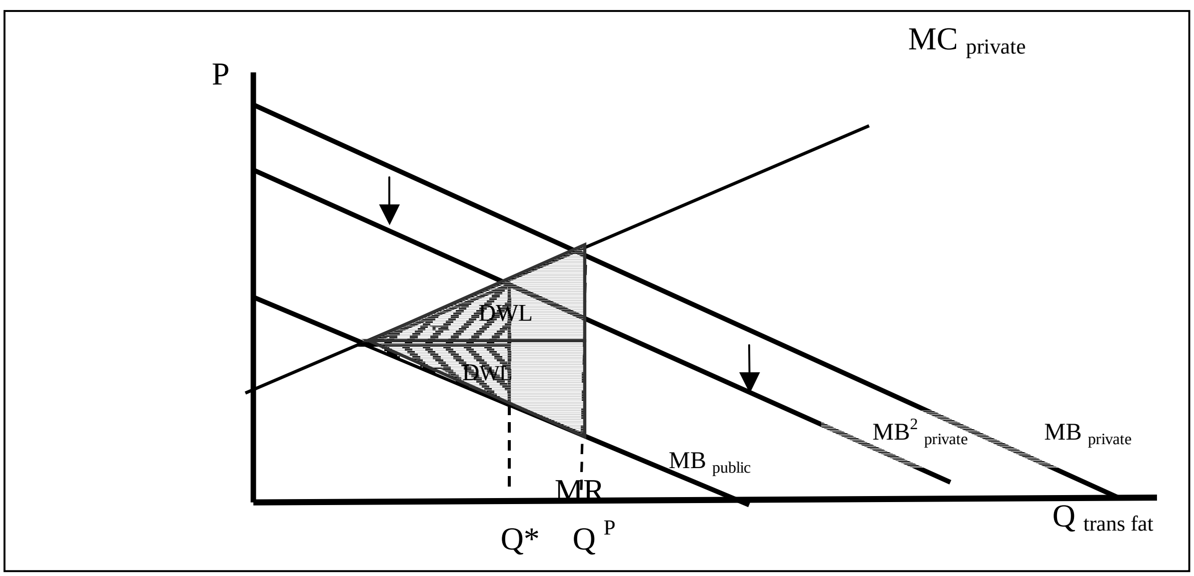
Finally it is important to note that the faster the ban is imposed the more firms will have to rely on existing technologies and substitutes that exist in the market place. If the ban were imposed quickly, the industry would be forced to rely heavily on palm oil and animal fat to replace hydrogenated fats. The more time the industry has to comply with a ban the more likely they are to develop other options such as HO canola to meet the requirements.

b. Elimination of External Impacts (Health Effects)

The reduction of trans fatty acid consumption can increase economic welfare and reduce deadweight-loss, by reducing the negative externality that occurs due to health care costs not (fully) paid by the consumer. When governments provide health insurance for some portion (or the entire) population, individuals tend to over consume goods with adverse health effects, for example smoking and drinking, which are called moral hazards (Cutler, 2002). Individuals only take into consideration their share of the effect (including cost and non-cost) for consumption decisions, which lead to a dead weight loss (DWL) because the external health cost is being paid by a third party.

When a functional food like Nexara canola reduces the risk of a chronic disease it diminishes the effect of this negative externality therefore, lessens the deadweight loss and increases economic welfare. The process is illustrated in Figure 18. When people are not informed about the adverse health effects related to trans fat consumption and there are no trans fat free substitutes available, they only take into consideration their immediate benefit from the consumption ($MB_{private}$). Which is much higher than the social benefit (MB_{social}) since the trans fat consumption is related to health care costs. If consumers are informed about the adverse health effects of trans fat consumption they would possibly reduce their consumption by a certain degree, because although they are not paying for the entire health care cost their utility is reduced from the consumption. When trans fat-free substitutes are available on the market (especially if their prices do not differ significantly) this gives an incentive to consumers to consume even less trans fat. Therefore the individual marginal benefit curve will shift down ($MB_{2Private}$) closer to the social marginal benefit, reducing the DWL.

Figure 18 Negative Externality Related to Trans Fat Consumption



TFA labelling and CHD risk reduction in US: "The FDA Report"[10]

The Food and Drug Administration (FDA) is amending its regulations to require that the level trans fatty acids be declared in the nutritional labels provided on conventional foods and dietary supplements. This information will appear on a separate line underneath the declaration of saturated fatty acids. The FDA has examined the economic implications of the final rule. They estimated the total costs and total benefits of this rule. The total cost of these regulations is the sum of the testing, re-labelling, and reformulation costs. In order to estimate the benefits of trans fat labelling, FDA estimated the health benefits associated with a reduction in consumption of trans fats due to the labelling change and the resulting changes in health status with regard to CHD risk reduction in terms of life-years gained, number of cases of deaths avoided and the dollar value of such benefits. Finally, FDA provided an overview of benefits and costs by comparing the two estimates. Detractors of the analysis argue that it is not possible to calculate such health benefits, that increases of LDL-C and CHD risk due to trans fat intake can not be quantified, and they suggest that the estimated health benefits of trans fatty labelling were too high. In this section, a brief overview of the FDA health benefits estimates due to tran fatty acids labelling will be provided and at the end of the section this health estimates will be compared to the associated costs of the labelling.

FDA projects that trans fat intake will decrease by 0.0378% of energy due to labelling at the effective date of rule (see Table below). This decrease will be composed of 0.0359% of energy due to removal of 10% of trans fat from margarine by reformulation, and an additional 0.0019% of energy due to direct consumer choice. The additional 0.0019% of energy represents 0.1% of all remaining trans fat from hydrogenated fat after margarine reformulation.

Table 15 – Estimated Decreases in Trans Fat Intake and Contribution from Food Groups Due to Labelling, at Effective Date of Rule

	Before Effective Date of Rule	Change at Effective Date of Rule	
	Mean daily *trans* intake[1]	Decrease in *trans* fat contribution from food group	Decrease in *trans* fat intake
Food group	Percent of energy from trans fat	Percent decrease in *trans* fat	Decrease in percent of energy from trans fat
Total Margarine	0.359%[2]	10%	0.0359%
Other food groups with partially hydrogenated fats and oils	1.605%	none	
Total from hydrogenated products	1.964%		
Total decrease due to reformulation			0.0359%
Additional decrease due to consumer choice			0.0019%[3]
Total decrease			0.0378%

[1] *Trans* fat intake for men and women age 20 and over from CSFII 1994–96, see table 1 of this document.
[2] *Trans* fat intake from margarine, 0.359 percent of energy, already decreased by 15 percent from intake in table 1, to account for margarine that has already been reformulated to decrease *trans* fat.
[3] Estimated decrease due to consumer choice at effective date is 0.1 percent of all remaining *trans* fat from hydrogenated fat after margarine reformulation.

Source: Federal Register, Department of Health and Human Services, Food and Drug Administration, 21 CFR Part 101. *Food Labelling; Trans Fatty Acids in Nutrition Labelling; Consumer Research to Consider Nutrient Content and Health Claims and Possible Footnote or Disclosure Statements; Final Rule and Proposed Rule.* /Vol. 68, No. 133/Friday, July 11, 2003/Rules and Regulations. (page 41474).

[10] Unless otherwise stated, note that all monetary values related to the FDA study are in US currency

The reduction of trans fat intakes due to labelling would also affect the health status of consumers in terms of changing the CHD risk. The calculation for change in CHD risk with substitution of cis-monounsaturated fat for 0.1% of energy from trans fat ranged from 0.14% to 0.29%. Table 16 below shows that, for Method 1, based on changes in LDL-C, replacement of 0.1% of energy from trans fat with the same percent of energy from cis-monounsaturated fat would decrease CHD risk by 0.147%. Based on changes in HDL-C, replacement of 0.1% of energy from trans fat would decrease CHD risk by 0.140%. For Method 2, based on changes in both LDL-C and HDL-C, the decrease in CHD risk would be 0.287%. Both methods, revealed a significant reduction of CHD risk due to trans fat reduction.

Table 16 – Sample Calculation for a Change in CHD Risk with Substitution of *Cis*-Monounsaturated Fat for Trans Fat

Estimation Method	Change in Trans Intake (% of Energy)	Type of Serum Lipid	Factor for Change in Serum Lipids (mg/dL per 1% of Energy)	Factor for Change in CHD Risk (% per mg/dL)	Factor for Adjustment of Regression Dilution	Change in CHD Risk (%)
Method 1 LDL	-0.1	LDL	1.5	0.7	1.4	-0.147
Method 2 LDL + HDL	-0.1	LDL	1.5	0.7	1.4	-0.147
		HDL	-0.4	-2.5	1.4	-0.14
		LDL+HDL				-0.287

Source: Federal Register, Department of Health and Human Services, Food and Drug Administration, 21 CFR Part 101. *Food Labelling; Trans Fatty Acids in Nutrition Labelling; Consumer Research to Consider Nutrient Content and Health Claims and Possible Footnote or Disclosure Statements; Final Rule and Proposed Rule.* /Vol. 68, No. 133/Friday, July 11, 2003/Rules and Regulations. (page 414880).

Given the above estimates, FDA estimated the value of changes in health status in terms of life-years gained, number of cases or deaths avoided and the dollar value of such benefits. FDA uses the value of CHD morbidity and mortality prevented which is estimated using two approaches: 1) the value of statistical life years (VSLY), and 2) the value of statistical life and discount rate (VSL). According to the FDA Report: "(VSLY)… it calculates benefits as the extensions to longevity multiplied by the value of such increases in life-years gained, plus the number of nonfatal cases prevented multiplied by the costs of nonfatal cases, plus the savings in medical costs associated with reduction in nonfatal CHD. The second calculation is like the first, except that it values reductions in mortality risk as the number of statistical deaths prevented multiplied by the willingness to pay to reduce the risk of death (rather than the extensions to longevity multiplied by the value of increases in life-years gained), and calculates the value of reducing the number of nonfatal cases as simply the savings in medical costs." (Federal Register, p.41488). By themselves, the deaths prevented demonstrate the effectiveness of trans fat labelling rule; add to this the very significant health benefits associated with such a ban.

Method 1 estimates the total benefit in millions of dollars for an additional year of life to be $234, $968 and $1,127 respectively (see Table below). Method 2 estimates the total benefit in millions of dollars for an additional year of life to be $477, $1,973 and $2,295 respectively. The total cost per nonfatal case is the sum of lost quality-adjusted life years multiplied by $100,000 per life year plus the medical costs of $22,700 plus $1,900 per year times the discounted life years. FDA estimated the morbidity cost per case to be about $282,000.

Table 17 – Benefits for Different Values of Statistical Life Years

Value of Statistical Life Years Gained	Discount Rate	Number of Discounted Life Years Gained		Mortality Related Benefits Estimated In Year 3 After the Effective Date and Annually Thereafter (in millions)		Total Benefits (in millions)	
		Method 1	Method 2	Method 1	Method 2	Method 1	Method 2
$100,000	7 percent	1,920	3,840	$192	$384	$234	$477
$300,000	3 percent	2,640	5,280	$792	$1,584	$968	$1,973
$500,000	7 percent	1,920	3,840	$960	$1,920	$1,127	$2,295

Source: Federal Register, Department of Health and Human Services, Food and Drug Administration, 21 CFR Part 101. *Food Labelling; Trans Fatty Acids in Nutrition Labelling; Consumer Research to Consider Nutrient Content and Health Claims and Possible Footnote or Disclosure Statements; Final Rule and Proposed Rule.* Vol. 68, No. 133/Friday, July 11, 2003, Rules and Regulations. (page 414889).

Table 18 illustrates the VSL estimates resulting from the TFA reduction. Method 1 estimates the total benefit in millions of dollars for an additional year of life to be $1,112, $1,442, $991 and $1,285 respectively. Method 2 estimates the total benefit in millions of dollars for an additional year of life to be $2,225, $2,884, $1,982 and $2,570 respectively.

Table 18 – Benefits for Different Values of Statistical Life and Discount Rate

VSL and Discount Rate	Expected Deaths Averted		Average Medical Costs per Nonfatal Case	Expected Nonfatal Cases Averted		Total Benefits Estimated in Year 3 After the Effective Date and Annually Thereafter (in millions)	
	Method 1	Method 2		Method 1	Method 2	Method 1	Method 2
$5,000,000 (3%)	240	480	$43,000	360	720	$1,112	$2,225
$6,500,000 (3%)			$43,000			$1,442	$2,884
$5,000,000 (7%)			$39,000			$991	$1,982
$6,500,000 (7%)			$39,000			$1,285	$2,570

Source: Federal Register, Department of Health and Human Services, Food and Drug Administration, 21 CFR Part 101. *Food Labelling; Trans Fatty Acids in Nutrition Labelling; Consumer Research to Consider Nutrient Content and Health Claims and Possible Footnote or Disclosure Statements; Final Rule and Proposed Rule.* /Vol. 68, No. 133/Friday, July 11, 2003/Rules and Regulations. (page 414889).

Lastly, FDA report compares the total costs and health benefits associated with the trans fat labelling. Table 19 shows the timing of the discounted benefits and costs estimated for this rule, as well as the totals. On the cost side, the costs for testing, re-labelling, and reformulation are all expected to occur by the first effective date of the final rule, or about 2 to 3 years after publication. The total cost is ranging from $139,000,000 (low estimates) to $275,000,000 (high estimates). The benefits reported in Table 19 are based on a VSLY (Value of Statistical Life Years) of $300,000 and a discount rate of 3%. Finally, the effectiveness of the trans fat labelling rule can be seen in the relatively low cost per life saved. For example, “if we express the one time costs as annualized cost over 20 years (discounted at 3%), the medium cost estimate in Table 19 comes to about $12 million per year. With Method 1, the cost per life year saved would be about $4,500 ($12 million/2,600 life years).” (Federal Register p. 414990). Note that the benefits are underestimated because the quality adjusted life years associated with nonfatal cases were not included.

Table 19 – Summary of Costs and Benefits by Year after Publication, Discounted to Effective Date, in Millions of Dollars

		Effective Date							
	Years After Publication	2	3	4	5	6	7		Cummulative Total as of Year 20
Costs									
Low		$139	none	none	none	none	none	...	$139
Medium		$185	none	none	none	none	none	...	$185
High		$275	none	none	none	none	none	...	$275
Benefits									
Method 1	Annual	none	none	none	$968	$940	$913	...	
	Cumulative				$968	$1,908	$2,821	...	$13,130
Method 2	Annual	none	none	none	$1,973	$1,916	$1,860	...	
	Cumulative				$1,973	$3,889	$5,784	...	$26,757

Source: Federal Register, Department of Health and Human Services, Food and Drug Administration, 21 CFR Part 101. *Food Labelling; Trans Fatty Acids in Nutrition Labelling; Consumer Research to Consider Nutrient Content and Health Claims and Possible Footnote or Disclosure Statements; Final Rule and Proposed Rule.* /Vol. 68, No. 133/Friday, July 11, 2003/Rules and Regulations. (page 414890).

In the FDA analysis the health cost benefits are about 100 times greater than the cost of labelling. To sum up, the average trans fat intake of US adults from food groups is for men 6.862, women 4.776 and average 5.840 grams per day. The FDA study estimates that the trans fat intake would be decreased by 0.0378% of energy due to labelling. The CHD risk, in turn, could be reduced by 0.147% with substitute cis-monounsaturated fat for trans fats. The estimated value of changes in health states in terms of life-years gained, number of cases or death avoided and dollar value of such benefits due to labelling (the VSLY and VSL measures) are between $13 and $26 billion over 20 years and by far outweigh the $130 to $230 million costs testing, re-labelling, and reformulation associated with the trans fat labelling.

Calculating per-unit External CHD Cost of Trans Fatty Acid Consumption in Canada

We estimate the possible health care savings under four different scenarios: low, base (most reasonable), high and extreme low (Table 20). Base estimate assumes that trans fat free vegetable oil will be used in 80% of the shortening oil market and 50% of the salad oil market, which together results in a 1.91 g daily trans fat reduction for every individual in Canada. Based on clinical trials that show that for every gram that trans fat is reduced, total cholesterol is reduced by 0.55%, which can reduce total cholesterol level by 2.96% on average. Based on the assumption that every percentage change in cholesterol level has a 2% reduction in CHD, CHD will see a reduction of 5.92%. The linkage between CHD and its cost is linear with a 1/1 ratio. The estimation of health care cost savings is $1,094 million (CAD) annually (Table 21).

Our high estimate is based on a more optimistic assumption: 80 percent market share in both the shortening and the salad oil markets, accounting for a 2.21 trans fat intake reduction per day. We do not assume the new canola oil will enter the margarine market because currently the new oil is only stable in liquid form. For the high estimation we also assumed that every percentage change in total cholesterol leads to a 3% change in CHD. With these assumptions the high estimate is $1,818 million (CAD) annually (Table 21).

The low estimation assumes that 50% of shortening oil and 20% of the salad oil market will be overtaken by trans fat free vegetable oils, accounting for a 1.12 g trans fat intake reduction per day. With the most acceptable 1 to 2 blood cholesterol to CHD risk ratio it still shows that a moderate consumption pattern change could reduce coronary heart disease by 3.46%. This still gives $639 million (CAD) health care cost savings annually (Table 21).

The extreme low is calculated to see how much the health care cost saving would be with a very modest estimation. This estimation assumes that the trans free oils reach a 50% market share in the shortening oil market and does not enter the salad oil market, accounting for a 0.98 g trans fat intake reduction per day. Moreover, instead of assuming a 1 to 1 linear correlation between CHD and its cost, we assume for every percentage of CHD change leads to 0.5% reduction in its cost. With these assumptions the calculated worst case in every step, the extreme low estimation, is still $280 million (CAD) cost reduction annually (Table 21).

Table 20 – Trans Fat Intake Reduction Scenarios due to Trans Fat Free Canola Oil*

	Total Shortening Oil Market[11] (in grams)	Assume reduction in Shortening Oil (%)	Total Salad Oil Market (in grams)	Assume reduction in Salad Oil (%)	Total Trans Fat Reduction[12] (in grams)
High	1.96	80.0%	0.68	80.0%	2.11
Base	1.96	80.0%	0.68	50.0%	1.91
Low	1.96	50.0%	0.68	20.0%	1.12
Extreme low	1.96	50.0%	0.68	0.0%	0.98

* See Table 1 for tarns fat consumption in Canada

[11] The total daily trans fat intake from Shortening and Salad Oil is calculated in Table 12

[12] The total Trans Fat reduction is calculated by multiplying the total shortening oil market with the assumed reduction percentile plus the same with salad oil.

Table 21 – Health Care Savings due to Total Cholesterol Reduction via Lower TFA Intake

	TC Change due to 1 gram TFA reduction daily[13]	Daily TFA Reduction [14]	Total Change in TC%	TC to CHD ratio[15]	Change in CHD%[16]	CHD to Cost Ratio	Total Annual CHD cost[17] (million of CAD)	Total Change in CHD cost[18] (million of CAD)
Base[19]	-1.55%	1.913	-2.96%	2.0	-5.92%	1.0	$18,473	-$1,094
Low [20]	-1.55%	1.118	-1.73%	2.0	-3.46%	1.0	$18,473	-$639
High[21]	-1.55%	2.12	-3.28%	3.0	-9.85%	1.0	$18,473	-$1,818
Extreme low[22]	-1.55%	0.98	-1.52%	2.0	-3.03%	0.5	$18,473	-$280

[13] Total cholesterol change due to 1 g of TFA reduction calculated as a weighted average of controlled medical trials in Table 12

[14] The daily TFA reduction detailed breakdown can be found in Table 12.

[15] The relationship between total cholesterol and coronary heart disease is 1: 2 based on Expert Panel, for the high estimates we used 1:3 ratio which assumed to be the long term ratio

[16] Change in CHD (%) is calculated by multiplying the TC to CH ratio with the total change in TC (%).

[17] Source: Burden of Illness in Canada, 1998. There is no newer reported data available at this point of time.

[18] Total change in CHD cost is calculated by multiplying the total annual CHD cost with the

[19] Best estimate assume: the shortening oil market will be overtaken by the trans fat free canola oil, every % of TC reduction lead to 2% reduction in CHD risk, also assumes the CHD has linear 1:1 relationship to its cost.

[20] Low estimates assumes that the same as the best except to be moderate the CHD to its cost ratio chosen to be only 0.5

[21] High estimate assumes that not only the shortening market but the salad oil market is going to use trans fat free products

[22] Extreme low estimates assume same as low except even the cholesterol reduction effect to the coronary heart disease is chosen to be only 1.5

Table 22 shows the calculated cost changes due to trans fat consumption per kg. Based on the different scenarios, the annual trans fat intake change varies between twenty-nine thousand kg per year, in our extreme low scenario, to sixty-three thousand kg per year, in our high scenario. Our calculated health care cost per kg of used TFA ranges from $9.43 in our extreme low scenario, to $18.87 in our high scenario. However, not all of the sold oils and fats end up in our diet, for example most oil used for frying is disposed of after use. Assuming 30% disappearance, the health care cost per kg of TFA sold in the market is $5.66 per kg using the base and low scenario, $8.49 per kg in the high scenario and $2.83 per kg in the extreme low scenario.

Table 22 - Health Care Externality per Kilogram[23]

	TFA Diet change[24] (g/ day)	Total Annual TFA change[25] (kg/year)	Total change in CHD cost	Cost of used TFA[26] (kg)	Cost of sold TFA (kg)[27]
Base	1.91	57,250.34	-$1,080.04	-$18.87	-$5.66
Low	1.12	33,495.91	-$631.91	-$18.87	-$5.66
High	2.11	63,345.13	-$1,792.53	-$28.30	-$8.49
Extreme low	0.98	29,432.72	-$277.63	-$9.43	-$2.83

The overall average reduction in serum cholesterol is equal to 1.548 % for every one gram of TFA reduction (or 15.48% for every 10 grams of TFA reduction, see Tables in Appendix 6 and 7, as well as the previous section of this paper). The TFA content in process canola oil is ranging from 20% (frying) to 50% (margarine) (List 2004). If Nexera canola is substituted for hydrogenated canola oil, which we assume on average to contain 30% TFA, and given the estimates of the health care externality of each kilogram of TFA sold (when TFA is completely eliminated in Canada), then the health care savings for each kg of Nexera canola is equal to $ 4.77 (ranging from $3.18 in a case of frying oils to $ 7.95 in a case margarine).

[23] Given that the estimated individual TFA consumption in Canada is 3.36 g/year (see Table 1; draft), (the TC change due to 1 gram TFA reduction daily is estimated -1.55%; and assuming 1:2 ratio between cholesterol and CHD), the total change in CHD cost is $1,901,610,000 if TFA consumption is completely eliminated in Canada. Furthermore assuming that 0% of TFA is consumed in Canada, the total annual TFA change (kg/year) is 100,712.64 kg/year, which result in $15.89 health care cost per kg of TFA sold in Canada (or $52.96 per kg consumed).

[24] Daily TFA intake change and total annual health care cost change was calculated previously.

[25] Total annual TFA intake change is calculated by multiplying the daily TFA intake change with the population and dividing it by 1000 to convert into kilograms

[26] The cost per kilogram is calculated by dividing the total annual cost change with the total annual TFA change

[27] Much of the fat used in the frying process is thrown out after use rather than being consumed. In reconciling the difference between reported human use consumption of visible fats and the actual dietary intake, it is estimated that approximately 70% of these fats never reach the stomach of consumers.

Substitution of Different Types of Fatty Acids for Trans Fatty Acids and CHD Risk

Trans Fat, Saturate fat and CHD risk: "The Danish Report"

Stender and Dyerberg (2003) (Danish Nutrition Council Report) project that the risk of heart disease in persons is increased as intake of trans fat and saturated fats are increased. The study shows a 25% increase in heart disease when trans fat intake is increased. Specifically, increasing your daily intake of saturated fat by 5 grams will increase your risk of heart disease by 2%. Increasing your daily intake of trans fat by the same amount will increase your risk of heart disease by 5% (see Table 23).

Table 23 – Increased Risk of Heart Disease in Persons with a Comparable Absolute Increase in Intake of Saturated Fat and Trans Fat

	INTAKE GRAMS/DAY	RISK INCREASE BASED ON INCREASED LDL/HDL RATIO	OBSERVED RISK INCREASE IN THE PROSPECTIVE POPULATION STUDIES
Saturated fat	5 (2 E%)	2%	2%
Trans fat	5 (2 E%)	5%	25%

E%: Per cent energy

Source: Stender S., and J. Dyerberg, 2003. *The Influence of Trans Fatty Acids on Health*. Fourth Edition. A report from the Danish Nutrition Council. Publ. no. 34. (http://www.ernaeringsraadet.dk/pdf/Transfedt_UK_ny.PDF). (page 27).

Different Macronutrient Substitutions for Trans Fatty Acids and Change in CHD Risk: "FDA Report"

The FDA Report outlines each type of macronutrient substitution for trans fat. They project that trans fat will be replaced by a combination of different types of fatty acids or carbohydrate due to the trans fat labelling rule, which in turn, will change the CHD risk. Table 21 gives examples of changes in CHD risk with replacement of 0.1 percent of energy from trans fat by different macronutrients and combinations of macronutrients. For example, based on changes in LDL-C (Method 1), the replacement of 0.1% of energy from trans fat with the same percent of energy from cis-polyunsaturated fat would decrease CHD risk by 0.177 percent. Similarly, based on changes in LDL-C (Method 1), the replacement of 0.1% of energy from *trans* fat with the same percent of energy from cis-monounsaturated fat would decrease CHD risk by 0.147%. While, based on changes in LDL+HDL (Method 2), a substitution of 0.1% of energy of cis-monounsaturated (cis-polyunsaturated fat) for trans fat would decrease CHD risk by 0.287% (0.296%).

Table 21 also includes estimates of the increased CHD risk when trans fat are replaced by 100 percent saturated fat. For example, based on changes in LDL-C, the replacement of 0.1% of energy from trans fat with the same percent of energy from saturated fat would increase CHD risk by 0.002%. While, based on changes in LDL+HDL (Method 2), a substitution of 0.1% of energy of saturated for trans fat would decrease CHD risk by 0.184%. FDA notes that "…this decrease in CHD due to 100% replacement of trans fat for saturated fat represent the relationship between HDL-C and CHD, a relationship that is more uncertain than the causal relationship between LDL-C and CHD" (Federal Registry p. 41481). Furthermore, FDA states that "…the available studies did not provide a definitive answer about whether trans fat has an effect on LDL-C and CHD risk equivalent to saturated fat on a gram-for-gram basis…the regression equations do predict a very similar increase in LDL-C with each one percentage of energy increase in either saturated fat or trans fat. Thus, Table 24[sic] in this document shoes that the change in LDL-C is negligible when one percentage of energy from trans fat is substituted for saturated fat." (Federal Registry p. 41482). It seems that there is some uncertainty about the comparative effects of saturated fat and trans fat on LDL-C. A number of other studies, as stated in FDA report suggested that hydrogenated fat or trans fat relative to saturated fatty acids, result in lower HDL cholesterol concentration, hence increase the CHD risk more than saturated fatty acids.

Table 24 – Summary of Changes in Serum Lipids and CHD Risk with Different Macronutrient Substitutions

A. Change in Serum Lipids With Substitution of *Trans* Fatty Acids for Different Types of Fatty Acids or Carbohydrate

Macronutrient	*Cis*-monounsaturated Fatty Acid	*Cis*-polyunsaturated Fatty Acid	Saturated Fatty Acid	Carbohydrate	Half cis-monounsaturated and half cis-polyunsaturated	Half cis-monounsaturated and half saturated	Half cis-monounsaturated and half carbohydrate
Change in Serum Lipid When Replaced by Trans Fat	mg/dL per 1% of energy	mg/dL per 1% of energy	mg/dL per 1% of energy	mg/dL per 1% of energy	mg/dL per 1% of energy	mg/dL per 1% of energy	mg/dL per 1% of energy
LDL	1.5	1.81	-0.02	1.26	1.66	0.74	1.38
HDL	-0.4	-0.34	-0.53	-0.06	-0.37	-0.47	-0.23

B. Change in CHD Risk With Replacement of *Trans* Fatty Acids By Different Types of Fatty Acids or Carbohydrate

Macronutrient	*Cis*-monounsaturated Fatty Acid	*Cis*-polyunsaturated Fatty Acid	Saturated Fatty Acid	Carbohydrate	Half cis-monounsaturated and half cis-polyunsaturated	Half cis-monounsaturated and half saturated	Half cis-monounsaturated and half carbohydrate
Change in CDH Risk With Replacment of *Trans* Fat	Percent per 0.1% of energy	Percent per 0.1% of energy	Percent per 0.1% of energy	Percent per 0.1% of energy	Percent per 0.1% of energy	Percent per 0.1% of energy	Percent per 0.1% of energy
Method 1, LDL	-0.147	-0.177	0.002	-0.123	-0.162	-0.073	-0.135
HDL	-0.140	-0.119	-0.186	-0.021	-0.130	-0.163	-0.081
Method 2, LDL + HDL	-0.287	-0.296	-0.184	-0.144	-0.292	-0.235	-0.216

Source: Federal Register, Department of Health and Human Services, Food and Drug Administration, 21 CFR Part 101. *Food Labelling; Trans Fatty Acids in Nutrition Labelling; Consumer Research to Consider Nutrient Content and Health Claims and Possible Footnote or Disclosure Statements; Final Rule and Proposed Rule.* /Vol. 68, No. 133/Friday, July 11, 2003/Rules and Regulations. (page 414881).

Finally, Table 25 predicts percentage decrease in CHD risk when different fats replace trans fat, three years after effective date for the First Rule. Substituting monounsaturated fat for trans fat decreases CHD risk by –0.056% in method one and –0.108% in method two, monounsaturated and saturated fat decreases the risk by –0.027% in method one and -0.090% in method two.

Table 25 – Predicted Changes in CHD Risk Due to Trans Fat Labelling According to Macronutrient Substitution for Trans Fat

Time after Effective Date for Final Rule[1]	Decrease in Trans Fat Intake (% of Energy)	Source of Decrease	Substitution for Trans Fat	Percent Decrease in CHD Risk		
				Method 1, LDL	HDL	Method 2, LDL and HDL
3 years	0.0378	Consumer choice and margarine reformulation	mono	-0.056%	-0.053%	-0.108%
			mono+ poly	-0.061%	-0.049%	-0.110%
			mono+ sat	-0.027%	-0.062%	-0.090%
			Substitution from probabilistic model.	-0.052%	-0.054%	-0.106%

[1] The time after the effective date for the final rule includes 3 years for decreases in *trans* fat intake to result in changes in CHD risk.

Source: Federal Register, Department of Health and Human Services, Food and Drug Administration, 21 CFR Part 101. *Food Labelling; Trans Fatty Acids in Nutrition Labelling; Consumer Research to Consider Nutrient Content and Health Claims and Possible Footnote or Disclosure Statements; Final Rule and Proposed Rule.* /Vol. 68, No. 133/Friday, July 11, 2003/Rules and Regulations. (page 55).

To sum up, according to FDA Report, cis-polyunsaturated fat, cis-monounsaturated fat, or a combination of cis-monounsaturated fat and cis-polyunsaturated fat could reduce the CHD risk when replacing trans fat. Conversely, when saturated fat replaces trans fat, the CHD risk could be slightly increased or reduced but by a smaller percentage than the other possible macronutrient substitution.

Overall Effect of TFA

There is some uncertainty about the comparative effects of saturated fat and trans fat on CHD risk. Stender and Dyerberg (2003) (Danish Nutrition Council Report) project that the consumption of trans fat increases the CHD risk more than the consumption of saturated fatty acids. While, FDA report projects that the substitution of saturated fatty acids for trans fat could have a negligible positive effect on CHD risk or reduce the risk.

In general, the predicted changes in CHD risk due to trans fat reduce consumption, is very substantial. The increased consumption of non-hydrogenated fats and oils, like Nexera canola that are low in TFA, would reduce the CHD risk, which in turn will result in significant health benefits and increased social welfare. Conversely, the switch to saturated fats in order to reduce the TFA consumption could hinder efficiency and reduce the health care savings resulting from the TFA reduction.

IV. Conclusions:

1. The upcoming requirements for mandatory labelling of trans fats in Canada and the United States has already resulted in the introduction of many trans fat free products in the market place that are being offered for sale at price very close to trans fat containing products. This suggests that for many food products there will be minor impact on consumer prices.

2. In the case of soft margarine and many bakery products, tropical oils that are high in saturated fatty acids have been used replace hydrogenated fats. If a ban were imposed immediately a similar substitution would take place on a broader scale increasing the use of tropical oils and reducing the demand for canola and soya oil used in Canada. While the cost implications for consumers would be very small, this would represent a major reintroduction of tropical oils into the Canadian diet.

3. The introduction of a large amount of tropical oil into margarine and cooking products would have very limited implications for canola producers as an increase in exports of oil at the prevailing world price could easily offset any reduction in domestic demand. For soybeans the impact could be somewhat larger if the industry move to a continual export price basis. The cost implications for oil processor will depend on the relative price of palm oil and canola oil and inward transportation costs. The net result may be a modest increase in the cost of formulation that would be passed onto consumers.

4. Given the current state of technology, individuals and companies associated with the production and marketing of stick margarine and bakery products (especially laminate goods like croissants) are more likely to be negatively impacted by a trans fat ban. These products do not have readily available substitutes that will ensure that the product characteristics remain consistent. These product characteristics include taste, mouth feel and shelf life. The manufactures of these products will struggle to find cost effective alternatives.

5. A trans fat ban will have a limited impact on the pocket book of consumers. Even a 60-cent/kg increase in the price of margarine would cost consumer less than one cent per day.

6. New product development is an expensive process. These are significant upfront costs that will likely mean that some of the businesses, particularly small ones, will not survive the transition to a trans fat free market. In assessing the impacts of a ban it is important to separate those costs associated with mandatory labelling, which is already law, and the additional costs that would be imposed by a subsequent trans fat ban. The timing for compliance would also affect these costs. If same firms are given a longer grace period, which they were granted in the labelling legislation, then they will have greater ability to develop new products and label them in one step rather than more expensive two step process where re-labelling would be required.

7. The modification of the fatty acid profile of canola and soybeans to increase oleic fatty acid offers considerable promise to address the demand for stable frying oils without the addition of saturated fats to the diet. The introduction of HO canola has already begun to occur in western Canada. However, a full-scale move away from trans fats may take some time. As markets continue to develop for these new products and the available varieties are expanded, acreage of HO canola will increase. This increase in HO production will provide small positive benefits to producers.

8. The monitory health impacts of fat consumption are very large relative to the costs of labelling of product reformulation. The United States FDA, found that over a twenty years period the health benefits from trans fat labelling was approximately 100 times greater than all of the costs associated with mandatory trans fat labelling. The Study by Malla et al. also shows very large positive health impact. Given that these large impacts are heavily influenced by the substitution that would take place in the case of a ban, it is very important to understand the nuance behind such impacts and have the science to support the estimated size and value of the impacts.

Opportunities for Further Research:

While a ban on trans fat provides significant health benefits, some effort should be made to examine other policy instruments. A ban is a very restrictive policy option. It has little flexibility and limited capability to adjust for nuance within the market place. The use of more competitive instruments may be of some benefit. Consideration should be given to the imposition of a tax rather than a ban. In addition, a public information campaign should be instituted. It may result in a substantial portion of the benefits without impeding on the rights of individuals.

Some thought must be given to widening the ban so that it restricts saturated fatty acids, as well as trans fats. The reduced benefits that occur when trans fats are replaced with saturates imply that the ban could possibly be extended to saturates as well.

Two other opportunities for further study relate to information. First, it is imperative that an improved understanding of the health impacts is strived for. We have attempted to evaluate the health benefits that accrue to society when diets change, however, these are rough estimates. A greater concentration of effort on the subject may result in significant dividends. Second, it would be helpful to grasp the interaction between labelling of trans fat content, consumer perceptions and consumer behaviour. Do consumers react in a rational manner based on full information or do they react based on limited understanding of the health issues and less than factual information.

Summary:

Market Impacts
For the most part, the market impacts of implementing a trans fat ban are relatively small. Generally, impacts occur at the crusher and food processor sectors, though these effects

are almost always passed through to consumers. Annual cost increases do not impact the industry sufficiently to forestall a ban on trans fat. The one-time transition costs are more substantial, though they are not insurmountable for most firms.

Health Effects

Removal of trans fat from the Canadian diet is seen as extremely beneficial both from a healthfulness, and a health-care cost, perspective. The gains from a trans fat ban would be hindered dramatically if such removals were allowed to be replaced by saturated fats. Canadians will gain the most if trans fat and saturates are removed from their diets.

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Appendix 1: Supply and Disposition of Selected Crops in Canada

Grain and Crop Year (a)	Seeded Area	Harvested Area	Yield	Productio n	Imports (b)	Total Supply	Exports (c)	Food and Indust. Use	Feed, Wate and Dockage	Seed	Total Domestic Use (d)	Ending Stocks	Average Price (e)
		000 ha	t/ha				thousand metric tonnes					tonnes	$/t
Canola													
1982-83		1,769	1.25	2,218	3	2,920	1,271	904	240	18	1,162	486	306.99
1983-84		2,314	1.12	2,593	6	3,102	1,498	1,159	301	24	1,484	120	439.11
1984-85		3,071	1.11	3,412	6	3,507	1,456	1,290	270	21	1,581	470	387.32
1985-86		2,783	1.25	3,498	11	3,969	1,456	1,211	330	22	1,563	950	303.02
1986-87		2,630	1.41	3,714	11	4,675	2,126	1,552	359	19	1,930	619	239.89
1987-88		2,614	1.42	3,720	10	4,348	1,750	1,608	328	26	1,962	636	335.00
1988-89		3,715	1.13	4,218	12	4,867	1,949	1,362	420	23	1,805	1,114	337.90
1989-90		2,918	1.1	3,209	7	4,330	2,038	1,229	283	31	1,543	749	303.70
1990-91		2,529	1.29	3,266	19	4,034	1,888	1,441	284	23	1,748	399	287.70
1991-92		3,141	1.34	4,224	42	4,664	1,894	1,829	184	24	2,037	734	274.40
1992-93		3,045	1.33	3,872	112	4,719	1,876	1,913	207	31	2,151	692	321.70
1993-94		4,124	1.34	5,525	23	6,240	3,348	2,196	325	42	2,563	330	392.70
1994-95		5,755	1.25	7,233	42	7,604	3,912	2,513	548	42	3,103	589	415.10
1995-96		5,271	1.22	6,434	97	7,121	2,804	2,753	504	30	3,287	1,030	433.80
1996-97		3,451	1.46	5,062	103	6,196	2,519	2,712	363	39	3,114	563	439.60
1997-98		4,870	1.31	6,393	141	7,097	2,964	3,239	488	43	3,770	363	419.70
1998-99		5,421	1.41	7,643	158	8,164	3,900	3,063	383	186	3,632	633	373.00
1999-00		5,564	1.58	8,798	124	9,556	3,885	2,983	492	39	3,514	2,157	287.97
2000-01		4,816	1.50	7,205	224	9,586	4,859	3,013	596	31	3,640	1,088	290.70
2001-02		3,765	1.31	4,926	226	6,240	2,524	2,293	176	33	2,502	1,214	357.45
2002-03		3,262	1.35	4,407	239	5,896	2,394	2,225	343	39	2607	894	415.09
2003-04	4,736	4,689	1.44	6,771	243	7,908	3,754	3,390	110	42	3,542	612	387.04
2004-05f	5,319	4,938	1.57	7,728	220	8,560	3,400	3,200	415	45	3,660	1,500	280-320
2005-06f	5,015	4,890	1.41	6,900	225	8,625	3,400	3,100	630	45	3,775	1,450	280-320

Source: Market Analysis Division, AAFC http://www.agr.gc.ca/mad-dam/e/index2e.htm

Grain and Crop Year (a)	Seeded Area	Harvested Area	Yield	Productio n	Imports (b)	Total Supply	Exports (c)	Food and Indust. Use	Feed, Wate and Dockage	Seed	Total Domestic Use (d)	Ending Stocks	Average Price (e)
		000 ha	t/ha				thousand metric tonnes					tonnes	$/t
Soybeans													
1982-83		364	2.33	848	419	1,356	117	1,043	14	24	1,081	157	245.59
1983-84		364	2.01	735	280	1,172	61	937	14	27	978	132	344.00
1984-85		405	2.26	917	228	1,305	124	928		36	964	218	270.00
1985-86		405	2.49	1,012	175	1,404	173	894	194	26	1,114	118	242.60
1986-87		385	2.49	960	217	1,295	147	953	14	65	1,032	115	232.42
1987-88		461	2.75	1,270	151	1,536	188	958	190	64	1,212	136	308.50
1988-89		533	2.16	1,153	159	1,448	294	855	69	66	990	164	310.10
1989-90		540	2.25	1,219	287	1,670	193	1,102	115	49	1,266	191	236.70
1990-91		484	2.61	1,262	164	1,617	213	936	187	70	1,193	210	224.50
1991-92		598	2.44	1,460	72	1,743	252	975	257	69	1,301	190	228.20
1992-93		622	2.33	1,453	226	1,871	211	1,000	296	250	1,546	114	264.50
1993-94		748	2.7	1,945	57	2,116	492	1,060	319	151	1,530	94	308.80
1994-95		821	2.6	2,254	67	2,415	542	1,122	526	56	1,704	168	272.40
1995-96		824	2.78	2,298	70	2,536	599	1,220	494	59	1,773	164	356.70
1996-97		862	2.51	2,170	232	2,565	478	1,424	513	71	2,008	80	382.30
1997-98		1,060	2.58	2,738	149	2,967	769	1,583	361	66	2,010	188	333.40
1998-99		980	2.79	2,737	254	3,178	876	1,576	444	68	2,088	215	266.00
1999-00		1,004	2.76	2,781	455	3,450	949	1,712	466	72	2,250	252	255.67
2000-01		1,061	2.55	2,703	431	3,386	747	1,697	693	64	2,454	185	256.09
2001-02		1,069	1.53	1,635	982	2,803	489	1,694	421	26	2,141	172	269.01
2002-03		1,024	2.28	2,336	651	3,159	723	1,763	419	109	2291	145	307.55
2003-04	1,051	1,047	2.17	2,268	587	3,000	913	1,500	319	128	1,947	140	395.04
2004-05f	1,229	1,178	2.59	3,048	300	3,488	950	1,500	488	125	2,113	425	205-245
2005-06f	1,215	1,199	2.5	3,000	250	3,675	900	1,500	490	360	2,350	425	185-225

Source: Market Analysis Division, AAFC http://www.agr.gc.ca/mad-dam/e/index2e.htm

Grain and Crop Year (a)	Seeded Area	Harvested Area	Yield	Productio n	Imports (b)	Total Supply	Exports (b)	Food and Indust. Use	Feed, Wate and Dockage	Seed	Total Domestic Use	Ending Stocks	Average Price (d)
		000 ha	t/ha			thousand metric tonnes							$/t
Sunflower Seed													
1991-92		82	1.63	134	12	158	71				65	22	229.00
1992-93		51	1.27	65	18	105	57				45	3	242.00
1993-94		77	1.02	79	13	95	44				45	6	320.00
1994-95		83	1.4	117	17	140	77				49	14	322.00
1995-96		45	1.48	66	13	93	35				47	11	354.00
1996-97		35	1.57	55	12	78	24				41	13	345.00
1997-98		51	1.28	65	12	90	45				42	3	344.00
1998-99		69	1.62	112	17	132	43				85	4	388.00
1999-00		79	1.54	122	19	145	49				55	41	295.00
2000-01		69	1.72	119	18	178	77				55	46	320.00
2001-02	73	67	1.55	104	29	179	92				65	22	355.00
2002-03	100	95	1.65	157	21	200	105				60	35	440.00
2003-04	119	115	1.3	150	16	201	96				80	25	405.00
2004-05f	87	59	0.92	54	25	104	40				59	5	480-510
2005-06f	100	95	1.47	140	15	160	80				70	10	410-440

Source: Market Analysis Division, AAFC http://www.agr.gc.ca/mad-dam/e/index2e.htm

Appendix 2: Grocery Price Survey Methodology and Results

This was a very informal survey. The objective was to gain an appreciation for the value of oil-containing food items and establish the degree to which price premiums are commanded regarding TFA-free products. In order to establish whether premiums exist, the survey was conducted in three cities (Calgary, Lethbridge, and Ottawa) during late February 2005. Products were chosen arbitrarily. They include crackers, muffins, packaged cookies, frozen french fries, potato chips, bucket margarine, cooking oil, and salad dressing. To the degree possible products were chosen to most closely represent those identified at the previous locations (made easier when national brands were tracked. However, packaging size differences skewed some of the results. Take special care in reading the package size information in the following tables. Note that all fresh baked muffins contained trans fats and were not collected once the survey began.

Grocery Store Food Price Survey

Calgary -- Safeway -- 16th Avenue North (central)

20-Feb-05

Item	Regular					Trans-Fat Free				
	Prices	*Quantity*	*Unit*	*Unit Price*	*Brand*	*Prices*	*Quantity*	*Unit*	*Unit Price*	*Brand*
Crackers (fish shaped)	$ 2.99	200	grams	$ 0.015	Ritz	$ 2.99	200	grams	$ 0.015	Goldfish
Muffins (fresh baked)*			grams					grams		
Packaged Cookies**	$ 3.29	350	grams	$ 0.009	Oreo	$ 3.29	350	grams	$ 0.009	Oreo
Frozen French Fries	$ 4.69	2000	grams	$ 0.002	McCain	$ 4.69	2000	grams	$ 0.002	McCain
Potato Chips	$ 3.49	370	grams	$ 0.009	Lays	$ 3.49	345	grams	$ 0.010	Lays
Bucket Margarine (canola	$ 3.99	907	grams	$ 0.004	Imperial	$ 4.54	907	grams	$ 0.005	Canola Harvest
Cooking Oil (canola)	$ 6.29	2000	ml	$ 0.003	Mazola	$ 6.99	1890	ml	$ 0.004	Canola Harvest
Salad Dressing (french)**	$ 2.89	475	ml	$ 0.006	Safeway	$ 2.19	250	ml	$ 0.009	kraft

* Freshed baked items at Safeway are made with lard or animal-derived shortening.
** No packaged cookies were found to be "transfat-free".
*** All Kraft salad dressings are TFA-free.
No "transfat-free" brick margarine items were found.
Brand identiy and package size are likely the leading factors in price differences.

Grocery Store Food Price Survey

Lethbridge -- Safeway -- South Side (suburban)

23-Feb-05

Item	Regular					Trans-Fat Free				
	Prices	*Quantity*	*Unit*	*Unit Price*	*Brand*	*Prices*	*Quantity*	*Unit*	*Unit Price*	*Brand*
Crackers (fish shaped)	$ 2.84	200	grams	$ 0.014	Ritz	$ 2.84	200	grams	$ 0.014	Goldfish
Muffins (fresh baked)*			grams					grams		
Packaged Cookies**	$ 3.29	350	grams	$ 0.009	Oreo	$ 3.29	350	grams	$ 0.009	Oreo
Frozen French Fries	$ 4.69	2000	grams	$ 0.002	McCain	$ 4.69	2000	grams	$ 0.002	McCain
Potato Chips	$ 3.32	370	grams	$ 0.009	Lays	$ 3.32	370	grams	$ 0.009	Lays
Bucket Margarine (canola	$ 3.79	907	grams	$ 0.004	Imperial	$ 3.79	907	grams	$ 0.004	Canola Harvest
Cooking Oil (canola)	$ 6.64	2000	ml	$ 0.003	Mazola	$ 5.41	1890	ml	$ 0.003	Canola Harvest
Salad Dressing (french)**	$ 2.29	475	ml	$ 0.005	Safeway	$ 2.11	250	ml	$ 0.008	Kraft

* Freshed baked items at Safeway are made with lard or animal-derived shortening.
** No packaged cookies were found to be "transfat-free".
*** All Kraft salad dressings are TFA-free.
No "transfat-free" brick margarine items were found.
Brand identiy and package size are likely the leading factors in price differences.

Grocery Store Food Price Survey

Ottawa -- Hartman's -- Bank Steet (central)

26-Feb-05

Item	Regular					Trans-Fat Free				
	Prices	*Quantity*	*Unit*	*Unit Price*	*Brand*	*Prices*	*Quantity*	*Unit*	*Unit Price*	*Brand*
Crackers (fish shaped)	$ 3.19	200	grams	$ 0.016	Ritz	$ 2.89	200	grams	$ 0.014	Goldfish
Muffins (fresh baked)*										
Packaged Cookies**		350	grams	$ -	Oreo		350	grams	$ -	Oreo
Frozen French Fries	$ 2.19	1000	grams	$ 0.002	McCain	$ 2.59	1000	grams	$ 0.003	McCain
Potato Chips	$ 2.29	454	grams	$ 0.005	Pres. Choice	$ 2.99	245	grams	$ 0.012	Lays
Bucket Margarine (canola	$ 3.59	907	grams	$ 0.004	Imperial	$ 4.99	907	grams	$ 0.006	Latancia
Cooking Oil (canola)	$ 4.99	2000	ml	$ 0.002	Pres. Choice	$ 4.99	1890	ml	$ 0.003	Canola Harvest
Salad Dressing (french)**	$ 1.99	475	ml	$ 0.004	Pres. Choice	$ 3.29	475	ml	$ 0.007	kraft

* Freshed baked items at Safeway are made with lard or animal-derived shortening.
** No packaged cookies were found to be "transfat-free".
*** All Kraft salad dressings are TFA-free.
Brick Margarine: No "transfat-free" items found.
Brand identiy and package size are likely the leading factors in price differences.

Appendix A3: Literature Review – Consumers' Attitudes, Acceptance and WTP

Author Year	**Purpose / Objective**	**Focus Area**	**Created for or by**	**Method**	**Result/implication**	**Focus Location**
Schmidt (2000)	Decide if the functional food enthusiasm is temporary or a permanent shift	Functional Food	International Food Information Council (IFIC)	Focus Group Telephone Survey	Consumer demand is increasing and their focus is shifting from reducing harmful ingredients toward incorporating healthier ingredients between 1996 and 2000	US
National Institute of Nutrition (2000)	Assess the Canadian consumer's attitude, and knowledge about health beneficial food items. Address and define the issues	Functional Food/ Nutraceuticals	National Institute of Nutrition (NIN), Agrifood Canada	Focus Groups, telephone interview 1003 in Canada	"Most consumers are interested but not well informed about functional food". (88% of participant are interested) Recommends that the "functional food" definition be used (61%).	Canada (US)
Veeman (2001)	Clear out the definitions and summarize the main issues within the industry	Novel Food/ Functional Food	Institute of Nutraceuticals and functional foods, Centre for Research in the Economics of Agrifood		More survey's needed to address the market, which may be changing. Regulations need to be balanced between consumer and producer interests.	Canada
Burton and Pearse,. (2002)	Asses consumers willingness to pay and attitude toward health benefit/ Genetic modification in food items (barley, beer)	Functional Food/ GM Food/	School of Agricultural & Resource Economics, University of Western Australia	Detailed questionnaire, drop of return mail and personal survey	The resistance toward GM is significant: 30% of responders refuse to buy GM, others heavily discount it Responders willing to pay price premium for health benefit and majority would accept genetic modification for health reasons.	Australia
West et al (2001,2004) Laure (2002)[1]	Asses consumers attitudes, beliefs and knowledge about different GM food and foods with health benefits	Novel Food/ Functional Food,/ GM Food/ Organic Food	Institute of Nutraceuticals and functional foods, Centre for Research in the Economics of Agrifood	A short questionnaire survey from 1080 people	Canadians will purchase functional food and majorities are willing to pay price premiums for health benefit. However (54%) are discounting genetic modification and 13% refuse to buy it.	Canada

[1] The researcher group firstly published their entire detailed result of the conducted survey in a research report (West et al (2001). Later they interpret the of the willingness to pay part (Laure et al.. 2004) and the assessment of the general knowledge part (West et al 2002) separately.

Appendix A4: Selected Novel Products with Functional Characteristic

Product with health benefit				
	Nexera Canola	Increased stability able to make non hydrogenated oil which therefore does not contain trans fat	This product has already been in the commercial food processing market since 1997, and is presently being used in Canada	Dow Agro science, Western Canada
	NuSunTM Mid-Oleic Sunflower Oil	Fatty acids altered (oleic acid higher, linoleic acid lower) it is not considered nutritional but is Non-GM	Approved and registered in Canada May 27, 2003	Archer Daniels Midland Company
	Low linolenic soybean line OT96-15	Lower linolenic acid levels	Approved and registered in Canada October 17, 2000	Agriculture and Agri-Food Canada
	High oleic soybean lines G94-1, G94-19, and G168	Higher levels of oleic acid	Approved and registered in Canada October 2, 2000 It was registered in US in 1996 Dec	DuPont (Canada) Inc.
	High oleic acid/Low linolenic acid canola (lines 45A37, 46A 40)	24% higher levels of oleic acid and 40% to 75% lower levels of linoleic and linolenic acid. The levels of tocopherols in P6 oil were lower than for regular canola oils, as was the peroxide value, which is consistent with P6 being a less unsaturated oil.	Approved and registered in Canada August 15, 1996	Pioneer Hi-Bred International

Appendix 5: Global & US Supply / Disposition of Selected Oils

CANOLA

World Production of Canola (rapeseed)

000 metric tonnes

Year	Australia	Canada	China	Czecho-slovakia	France	Germarry	India	Pakistan	Poland	Sweden	United Kingdom	Former USSR	World Total	
1992-93	179	3,872	7,653	375	1,810	2,617	4,872	243	758	247	1,150	329	25,285	24105
1993-94	305	5,480	6,940	377	1,550	2,848	5,390	225	594	313	1,136	211	26,735	25369
1994-95	309	7,233	7,492	452	1,800	2,837	5,884	225	756	214	1,298	244	30,310	28744
1995-96	557	6,436	9,777	662	2,700	3,127	6,000	255	1,377	215	1,330	252	34,435	32688
1996-97	624	5,062	9,200	521	2,870	2,150	6,942	255	449	139	1,410	226	31,531	29848
1997-98	856	6,392	9,578	575	3,496	2,867	4,935	286	595	132	1,527	221	33,108	31460
1998-99	1,690	7,643	8,300	680	3,734	3,388	4,900	292	1,099	129	1,566	339	35,885	33760
1999-00	2,460	8,798	10,132	931	4,392	4,285	5,110	279	1,132	154	1,737	505	42,525	39915
2000-01	1,905	7,205	11,381	844	3,481	3,286	3,725	297	958	112	1,157	522	37,559	34873
2001-02	1,797	4,926	11,331	973	2,874	4,160	4,500	231	1,064	112	1,157	440	35,995	33565
2002-03	841	4,178	10,552	710	39317	3,870	3,600	221	995	165	1,468	493	32,453	66410
2003-04	1,400	6,670	11,600	400	0	0	5,800	241	750	0	0	0	37,990	26861

World Supply and Disappearance of Canola and Products

000 metric tonnes

	Canola					Canola Meal					Canola Oil				
	Production	Exports	Imports	Cons-sumption	Ending Stocks	Production	Exports	Imports	Cons-sumption	Ending Stocks	Production	Exports	Imports	Cons-sumption	Ending Stocks
1996-97	31,531	5,673	5,967	28,853	2,047	17,531	4,361	4,023	17,265	510	10,525	2,625	2,547	10,507	390
1997-98	33,108	6,902	6,757	31,204	1,081	18,838	4,581	4,417	18,742	442	11,425	3,024	2,685	11,030	446
1998-99	35,885	6,836	6,990	31,952	2,241	19,173	2,052	2,167	19,365	365	11,847	1,844	1,625	11,586	488
1999-00	42,525	8,912	8,988	37,346	4,116	22,451	2,719	2,652	22,400	349	13,728	1,798	1,522	13,381	559
2000-01	37,559	7,852	7,402	35,189	2,666	21,171	2,212	2,173	21,151	330	13,032	1,183	1,229	12,949	688
2001-02	35,995	5,844	5,648	33,201	2,712	20,057	1,883	1,834	20,076	262	12,677	1,186	1,085	12,723	541
2002-03	32,453	4,687	4,511	31,211	1,842	18,850	1,938	1,927	18,830	271	11,781	1,042	1,096	11,927	449
2003-04	37,990	5,413	5,204	35,393	1,750	21,449	2,404	2,227	21,295	248	13,291	1,226	1,211	13,293	432

US Supply and Disappearance of Canola and Canola Oil

000 metric tonnes

	Canola							Canola Oil						
	Stocks Jun-01	Production	Imports	Total Supply	Crush	Exports	Total Demand	Stocks Jun-01	Production	Imports	Total Supply	Domestic	Exports	Total Demand
1996-97	40	219	259	518	395	79	474	35	155	502	692	529	133	662
1997-98	36	355	355	746	589	126	715	30	205	504	739	529	158	687
1998-99	19	710	310	1039	698	246	944	52	250	503	805	603	123	726
1999-00	77	621	242	940	722	136	858	79	281	534	894	669	129	798
2000-01	50	909	217	1176	773	220	993	96	292	545	933	797	85	882
2001-02	39	908	125	1072	757	218	975	51	266	503	820	680	116	796
2002-03	68	706	197	971	587	284	871	24	246	445	715	604	73	677
2003-04	72	686	290	1048	764	195	959	38	299	600	937	837	75	912

Prices of Canola and Products (Canada and US)

	Vancouver Canola $C per tonne	Vancouver Canola cents per pound (Can)	US Mid-West Canola Oil cents per pound (US)
1996	445.36	20.20	58.11
1997	423.24	19.19	88.00
1998	418.87	19.00	28.67
1999	335.01	15.19	20.23
2000	274.95	12.47	16.38
2001	322.38	14.62	18.86
2002	366.74	16.63	27.17
2003	346.48	15.71	27.20

Appendix 5: Global & US Supply / Disposition of Selected Oils

SOYBEAN

World Supply and Disappearance of Soybean Oil

000 metric tonnes

Year Beginning Oct. 1	Production: Brazil	Production: European Union	Production: United States	Production: Total	Exports: Brazil	Exports: United States	Exports: Total	Imports: India	Imports: Total	Consumption: Brazil	Consumption: European Union	Consumption: India	Consumption: United States	Consumption: Total	Stocks: United States	Stocks: Total
1994-95	3,796	2,708	7,082	20,161	1,486	1,217	6,287	60	5,986	2,466	2,040	555	5,857	19,209	516	2,026
1995-96	4,034	2,529	6,913	19,860	1,600	450	5,285	60	5,273	2,530	2,031	772	6,108	19,604	914	2,270
1996-97	3,723	2,582	7,145	20,318	1,268	922	6,004	49	5,904	2,600	1,784	706	6,471	20,544	690	1,944
1997-98	3,740	2,746	8,229	23,562	1,191	1,397	8,062	236	6,814	2,749	1,706	1,095	6,922	22,308	627	1,950
1998-99	3,931	2,753	8,202	24,650	1,381	1,076	8,170	833	7,850	2,850	1,694	1,805	7,101	24,500	689	2,170
1999-00	4,025	2,513	8,085	24,640	1,150	624	6,530	790	6,430	3,000	1,482	1,582	7,283	24,160	904	2,580
2000-01	4,319	2,982	8,355	26,750	1,530	636	7,250	1,400	6,900	3,075	1,929	2,020	7,401	26,250	1,255	2,720
2001-02	4,708	3,114	8,572	28,870	1,775	1,143	8,580	1,550	8,260	3,100	2~015	2,387	7,635	28,690	1,070	2,570
2002-03	5,250	2,810	8,363	30,490	2,245	1,026	9,490	1,275	9,140	3,150	1,871	1,966	7,752	30,930	676	1,790
2003-04	6,040	3,106	7,430	32,010	2,750	386	9,640	1,150	9,570	3,325	2,158	2,085	7,371	32,100	456	1,630

US Supply and Disappearance of Canola and Canola Oil

000 metric tonnes

					Domestic Disappearance									
						Food					Non-Food			
Year Beginning Oct. 1	Production	Imports	Stocks Oct. 1	Exports	Total Domestic	Shortening	Margarine	Cooking & Salad Oils	Other Edible	Total Food	Paint & Varnish	Resins & Plastics	Total Non-Food	Total Disappearance
1994-95	15,613	17	1,103	2,680	12,916	4,714	1,693	5.546	222	12,175	49	124	287	15,597
1995-96	15,240	95	1,137	992	13,465	4,702	1,699	5,317	159	11,877	48	119	297	14,457
1996-97	15,752	53	2,015	2,033	14,267	4,578	1,667	6,119	68	12,432	51	132	333	16,300
1997-98	18,143	60	1,520	3,079	15,262	4,688	1,623	6,188	78	12,576	49	128	490	18,341
1998-99	18,078	83	1,382	2,372	15,651	4,842	1,589	6,191	120	12,743	37	117	576	18,023
1999-00	17,825	83	1,520	1,376	16,057	7,153	1,481	7,075	132	15,841	65	96	586	17,433
2000-01	18,420	73	1,995	1,401	16,210	8,044	1,294	7,310	125	16,772	60	86	535	17,611
2001-02	18,898	46	2,767	2,519	16,833	8,572	1,242	7,880	125	17,818	60	85	519	19,352
2002-03	18,438	46	2,359	2,261	17,091	8,393	1,179	7,912	119	17,604	64	88	520	19,352
2003-04	16,380	235	1,491	850	16,250						65	75	607	17,100

Prices of Soybean Oil

	Decatur, Il Soybean Oil cents per pound (US)
1994	27.51
1995	24.70
1996	22.50
1997	25.84
1998	19.88
1999	15.60
2000	14.09
2001	16.46
2002	22.04
2003	29.62

Appendix 5: Global & US Supply / Disposition of Selected Oils

PALM

World Production of Palm Oil

000 metric tonnes

Crop Year	Brazil	Came-roon	Colom-bia	Costa Rica	Ecuador	Ghana	Indo-nesia	Ivory Coast	Malay-sia	Nigeria	Papua/N Guinea	Thailand	World Total	
1993-94	80	90	348	84	166	50	3,630	305	7,103	640	212	311	13,793	13019
1994-95	85	125	391	88	194	74	4,144	282	7,771	661	223	346	15,073	14384
1995-96	90	130	393	93	220	79	4,587	277	8,264	667	236	369	16,152	15405
1996-97	90	161	440	97	200	83	5,078	258	9,000	678	248	438	17,569	16771
1997-98	88	140	439	108	205	107	5,320	270	8,509	688	206	469	17,305	16549
1998-99	91	134	466	116	247	110	6,011	265	9,759	713	257	540	19,502	18709
1999-00	105	138	513	136	233	109	6,855	283	10,492	735	300	533	21,281	20432
2000-01	109	143	561	138	196	108	7,725	226	11,940	763	334	597	23,730	22840
2001-02	115	144	517	140	213	108	8,790	238	11,856	774	338	597	24,747	23830
2002-03	128	146	572	143	255	111	9,480	254	12,520	782	310	613	26,251	25314

Supply and Disappearance of Palm Oil in the US

000 metric tonnes

				------------- Consumption --------------					------------------ Prices -----------------		
Year Beginning Oct. 1	Stocks Oct. 1	Imports	Total Supply	Edible Product	Inedible Products	Total End Products	Total Disap-pearance	Exports	U.S. Import Value	Malaysia, FO.B., RBD	Palm Kemal Oil, Malaysia, NY. Rotterdam
				---------- in million pounds -----------					--------- U.S. $ per metric tonne --------		
1993-94	14.9	167.0	181.9	86.2	118.2	204.4	162.0	3.6	370	451	566
1994-95	16.4	98.7	115.1	38.1	113.6	151.7	101.8	5.9	538	647	680
1995-96	7.4	106.9	114.3	6.7	103.9	110.6	91.1	9.2	511	545	729
1996-97	14.0	146.4	160.4	w	91.8	w	164.6	4.2	432	544	680
1997-98	21.4	128.0	149.4	w	93.8	w	155.3	4.4	464	640	653
1998-99	16.1	128.8	144.9	w	72.4	w	173.2	5.2	...	514	708
1999-00	21.1	156.6	177.7	w	55.0	w	183.4	3.4	....	338	533
2000-01	25.7	175.5	201.2	w	36.0	w	167.7	6.0	....	272	313
2001-02	27.5	218.7	246.2	w	22.6	75.1	215.9	6.2	....	359	379
2002-03	26.0	195.0	221.0	w	w	76.7	185.0	7.1	....	438	455

Prices of Palm Oil

	US Ports Palm Oil cents per pound (US)
1994	28.09
1995	33.02
1996	26.54
1997	27.25
1998	31.92
1999	22.86
2000	16.28
2001	15.73
2002	23.31
2003	31.76

Appendix 5: Global & US Supply / Disposition of Selected Oils

CORN

Supply and Disappearance of Corn Oil in the US

million pounds

Crop Year Beginning Oct. 1	Supply: Stocks Oct. 1	Supply: Pro-duction	Supply: Total Imports	Supply: Total Supply	Disappearance: Baking and Frying Fats	Disappearance: Salad and Cooking Oil	Disappearance: Marg-arine	Disappearance: Total Edible Products	Disappearance: Domestic Disap-pearance	Disappearance: Exports	Disappearance: Total Disap-pearance
1997-98	129	2,335	28.1	2,492	W	375	W	492	1,272	1,118	2,390
1998-99	102	2,374	42.4	2,518	W	384	W	496	1,394	989	2,383
1999-00	135	2,501	17.5	2,654	W	800	W	953	1,417	970	2,387
2000-01	267	2,403	27.3	2,698	W	956	W	1,298	1,630	951	2,581
2001-02	117	2,461	61	2,639	W	W	W	950	1,363	1,172	2,535
2002-03	104	2,453	65	2,622					1,618	890	2,508
2003-04	114	2,650	65	2,829					1,804	900	2,704

Prices of Corn Oil (Wet Milled)

	Chicago Corn Oil cents per pound (US)
1997-98	28.94
1998-99	25.30
1999-00	17.81
2000-01	13.54
2001-02	19.14
2002-03	28.17
2003-04	28.14

Appendix 5: Global & US Supply / Disposition of Selected Oils

COCONUT

World Supply and Disappearance of Coconut Oil

000 metric tonnes

	Production							Consumption						Ending Stocks		
Year	India	Indo-nesia	Mal-aysia	Philip-pines	Total	Exports	Imports	European Union	India	Indo-nesia	Philip-pines	United States	Total	Philip-pines	United States	Total
1993-94	343	704	32	1,242	3,009	1,361	1,437	547	346	337	294	483	2,962	181	74	457
1994-95	383	638	36	1,564	3,312	1,775	1,760	660	384	492	309	491	3,325	99	74	430
1995-96	397	612	35	1,206	2,912	1,374	1,405	606	396	373	306	427	3,005	100	38	368
1996-97	424	756	35	1,257	3,150	1,726	1,658	688	432	213	339	504	3,067	92	68	384
1997-98	442	652	39	1,628	3,411	2,125	2,111	771	440	211	302	540	3,184	32	178	598
1998-99	431	458	51	783	2,369	1,040	1,136	578	446	110	295	461	2,744	58	69	319
1999-00	421	787	54	1,198	3,100	1,805	1,725	754	435	110	299	420	2,927	112	62	412
2000-01	431	700	49	1,731	3,517	2,182	2,179	729	448	280	348	437	3,357	60	118	570
2001-02	421	746	49	1,441	3,213	1,828	1,878	693	448	304	372	516	3,346	60	103	486
2002-03	435	756	55	1,292	3,085	1,782	1,784	634	458	245	362	463	3,187	55	67	387

Supply and Disappearance of Coconut Oil in the US

million pounds

	--- Rotterdam ---						----- Disappearance -----			Production of Coconut Oil (Refined)				
	Copra Tonne	Coconut Oil, CIF	Imports For Con-sumption	Stocks Oct. 1	Total Supply		Total Domestic	Edible Products	Inedible Products		Oct.- Dec.	Jan.- Mar.	April- June	July- Sept
Year	---- $ U.S. ----					Exports				Total				
1993-94	388	564	999	251	1,250	20	1,067	234	716	536.2	155.6	129.0	131.8	119.8
1994-95	432	656	1,100	163	1,263	18	1,082	247	694	546.8	137.5	142.7	144.3	122.3
1995-96	487	746	873	163	1,036	11	941	221	453	445.0	127.5	118.4	132.8	66.4
1996-97	452	693	1,188	83	1,271	11	1,111	120	471	324.2	77.0	61.5	101.5	84.2
1997-98	391	625	1.44	149	1,589	7	1,190	141	472	397.8	113.4	103.6	100.4	80.4
1998-99	468	748	791	392	1,183	11	1,021	144	380	363.2	89.6	82.9	99.3	91.4
1999-00	357	539	926	152	1,078	14	927	221	371	442.3	69.1	117.0	129.6	126.7
2000-01	208	323	1,100	136	1,236	8	968	237	297	534.9	135.7	128.3	146.9	124.0
2001-02	245	388	1,150	260	1,410	11	1,100	294	302	501.8	139.5	126.1	115.4	120.8
2002-03	293	458	1,150	301	1,451	10	1,201	305	310	546.7	128.8	137.0	155.6	125.2

Prices of Coconut Oil (Crude)

	New York Coconut Oil cents per pound (US)
1994	30.35
1995	34.02
1996	42.42
1997	39.40
1998	37.23
1999	39.89
2000	23.34
2001	24.15
2002	21.94
2003	24.05

Appendix 6

Total Cholesterol Level Changes due to Changed TFA Levels in Controlled Diet

Study Authors and year	Number of Subjects[28]	Total change in TFA /day[29] (grams)	Baseline TC[30] (mmol/L)	Endline TC (mmol/L)[30]	Total Change in TC[31]	Projected Change in 1g TFA D in TC [32]
Mauger et all. (2003)[33]	18/18	2.0	5.800	6.500	12.07%	6.03%
		8.8	5.800	6.000	3.45%	0.39%
		13.0	5.800	6.100	5.17%	0.40%
		25.5	5.800	6.300	8.62%	0.34%
Lichtenstein et al (1999)	18/18	6.9	5.818	5.999	3.11%	0.45%
		9.4	5.818	6.077	4.45%	0.47%
		19.6	5.818	6.284	8.01%	0.41%
		1.0	5.818	6.491	11.57%	11.57%
Dyerberd et al	0/87	3.4	4.500	4.600	2.22%	0.65%
Judd et all 2000	45/42	3.1	5.260	5.460	3.80%	1.23%
		5.9	5.260	5.520	4.94%	0.84%
Sundram et all	45/42	13.1	5.370	5.628	4.80%	0.37%
Zock and Katan 1992	45/42	6.3	4.740	4.890	3.16%	0.50%
		21.4	4.740	4.900	3.38%	0.16%
Zock et all 1993	36/23	1.9	4.960	5.190	4.64%	2.44%
		0.3	4.96	4.53	-8.67%	-28.90%
Aro et al 1996	49/31	-1.1	5.420	4.710	-13.10%	11.91%
		22.6	5.29	4.67	-11.72%	-0.52%
Müller et al 1998		15.3	4.46	4.67	4.04%	0.26%
Almendingen et al 1995		1	4.87	5.15	5.75%	5.75%
		4	4.87	4.97	2.05%	0.51%
Average[34]						1.548%

[28] The number of subjects is shown in the following form: number of women / number of men

[29] For harmonizing purposes all the dietary fat changes were converted into changing grams per day using the following measurement conversions: 1 g fat = 9 kcal, 1 MJ = 238 Kcal

[30] The Baseline and Endline (after diet change) cholesterol levels were harmonized and converted into the same measurement unit with the following conversion scheme: 1 mmol/l= 38.67 mg/dl

[31] Total change in TC (%) is shows the proportional difference between the Baseline and Endline TC t

[32] It is calculated by dividing the total change in TC (%) with the Total change in TFA, which means we are assuming linear correlation.

[33] These studies do not have complete information about the baseline diet (cholesterol levels are not measured at the baseline or he TFA intake is not given), therefore one of the experimental trials is chosen to be the baseline for the comparison (the lowest TFA levels diet was picked)

[34] The average calculation excludes the two extreme cases (Lichtenstein et al last trial and Zock et al last trial), that are shaded in grey in the table

Appendix 7

LDL, HDL and Their Ratio Changes
(Due to changes in TFA levels in a controlled diet)

Study Authors	Number of Subjects[28]	Change in TFA (grams)[29]	base LDL[30] (mmol /l)	base HDL[30] (mmol /l)	Base LDL/ HDL ratio[35]	End line LDL[30]	End line HDL[30]	End line LDL/ HDL	Total Change LDL/HDL ratio[36]	Projection to 1 g change
Mauger et al	18/18	2.0	4.000	1.110	3.604	4.600	1.160	3.966	10.04%	5.02%
		8.8	4.000	1.110	3.604	4.100	1.100	3.727	3.43%	0.39%
		13.0	4.000	1.110	3.604	4.200	1.110	3.784	5.00%	0.38%
		25.5	4.000	1.110	3.604	4.300	1.080	3.981	10.49%	0.41%
Lichtenstein et al, one diet excluded	18/18	6.9	3.982	1.112	3.581	4.112	1.112	3.698	3.26%	0.47%
		9.4	3.982	1.112	3.581	4.241	1.112	3.814	6.50%	0.69%
		19.6	3.982	1.112	3.581	4.344	1.109	3.918	9.42%	0.48%
		1.0	3.982	1.112	3.581	4.577	1.116	4.100	14.49%	14.49%
Dyerberd et al	0/87	3.4	2.680	1.320	2.03	2.810	1.260	2.230	9.84%	2.90%
Judd et all		3.1	3.340	1.420	2.352	3.540	1.400	2.529	7.50%	2.42%
		5.9	3.340	1.420	2.352	3.600	1.380	2.609	10.91%	1.85%
Sundram et	45/42	13.1	3.350	1.440	2.326	3.601	1.431	2.516	8.17%	0.62%
Zock and Katan	45/42	6.3	2.830	1.470	1.925	3.000	1.450	2.069	7.47%	1.19%
		21.4	2.830	1.470	1.925	3.070	1.370	2.241	16.40%	0.77%
Zock et al	36/23	1.9	2.980	1.520	1.961	3.090	1.650	1.873	-4.48%	-2.36%
		0.3	2.98	1.52	1.961	2.6	1.5	1.733	-11.59%	-38.63%
Aro et al	49/31	-1.1	3.130	1.600	1.956	2.890	1.420	2.035	4.04%	-3.67%
		22.6	3.2	1.46	2.192	3.13	1.22	2.566	17.05%	0.75%
Average[34]										0.82%

[35] The LDL/HDL ratio is simply calculated by dividing the LDL (given in mmol/l) with the HDL (also given in mmol/l)

[36] Change in LDL/HDL ratio is calculated by subtracting the Endline LDL/HDL ratio from the Baseline LDL/HDL ratio