

Methods & Opportunities for Reducing or Eliminating Trans Fats in Foods

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AAFC Objective re: Trans Fat Issue

- Task Force on Trans Fats
- Commission three studies
 - ✓ Alternatives
 - ✓ Industry Perspectives
 - ✓ Economic
- **This study** - Alternatives
 - ✓ Methods to reduce or eliminate TFA
 - ✓ Initiatives
 - ✓ Innovative opportunities

Agenda for this Presentation

- Background
- Methods Available to Industry
- Initiatives to Reduce Trans Fats
- Innovation Opportunities
- Closing Remarks

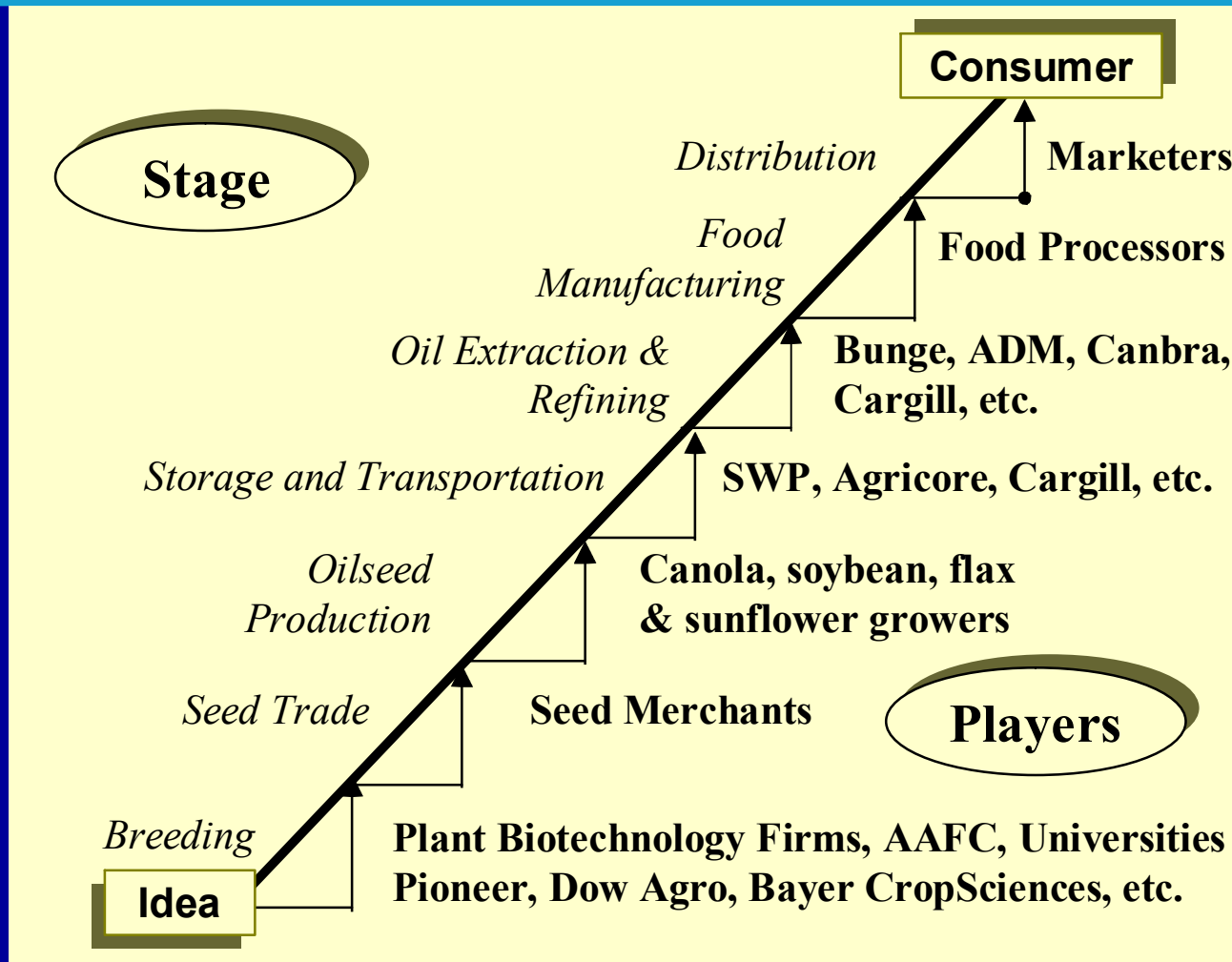
Trans Fat Issue

- Things to consider
 - ✓ Nutrition research
 - ✓ Methods & Alternatives
 - ✓ The target(s)
 - ✓ Is industry ready? How ready?
 - ✓ Solutions – surmountable or pipe dream?
 - ✓ Investment *versus* benefit?
 - ✓ Communications - ?
- **This report** - Alternatives
 - ✓ Methods to reduce or eliminate Trans Fatty Acids (TFA)
 - ✓ Initiatives
 - ✓ Innovative opportunities

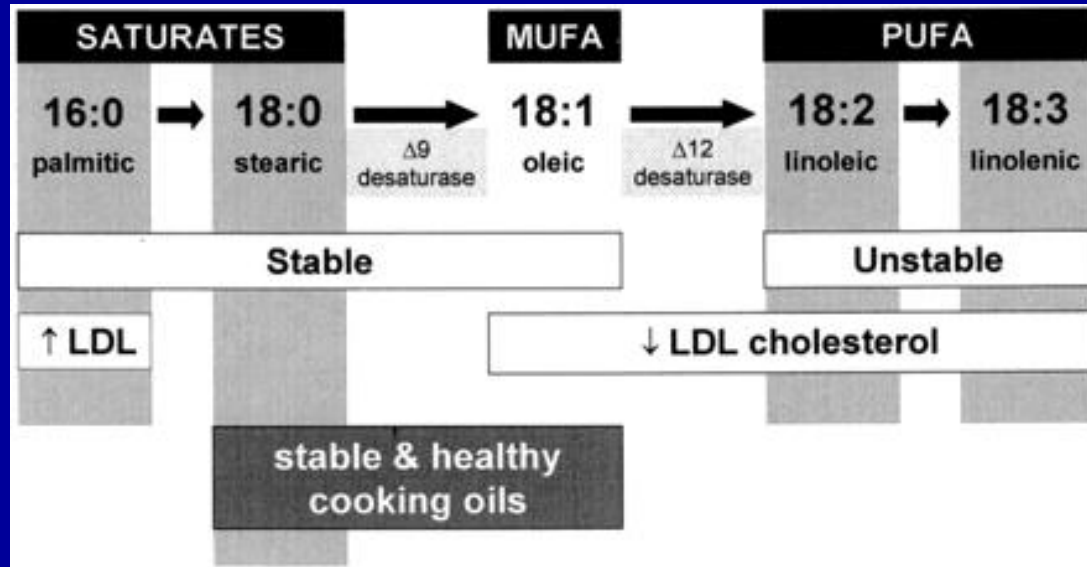
TFA Reduction – Public Health Objective

- **Multi-stakeholder issue** /.....opportunity?
 - ✓ Was this on the players agenda? Yes, sort of Consumer aware? Some! Are we doing it right ...??
 - ✓ 3 main players with different roles
 - ✓ Challenge to align the players with the Objective re: Authority, Responsibility, Accountability, Communications, Resources
- **Food Industry**
 - ✓ Practice change
 - ✓ Innovative products
- **Consumers**
 - ✓ Be aware of food product choices
 - ✓ Choose healthy foods and lifestyles
- **Governments**
 - ✓ Be certain of the science
 - ✓ Impacts of change – have to understand
 - ✓ Guide – via regulation, by example, by inducement (might cost \$)
 - ✓ Communicate – credible and consistent message

Edible Oil Value Chains



Functional Properties of Edible Oils



- **Plant breeders in late 1980s & early 1990s**
 - ✓ Developed 85% – 90% oleic acid varieties in canola, sunflower
 - ✓ Less fried food flavor compared to moderate 75% - 80% oleic
- **Recommendation by Warner *et al* for salad and cooking oils**
 - ✓ < 3% 18:3, < 7 – 8% saturate, not more 80% oleic, 20 – 30% 18:2
 - ✓ Until recently, only high oleic low linolenic canola oil had this profile
- **Balanced scorecard**
 - ✓ Physical / nutritional properties; profile of unsaturate, saturate & trans FA

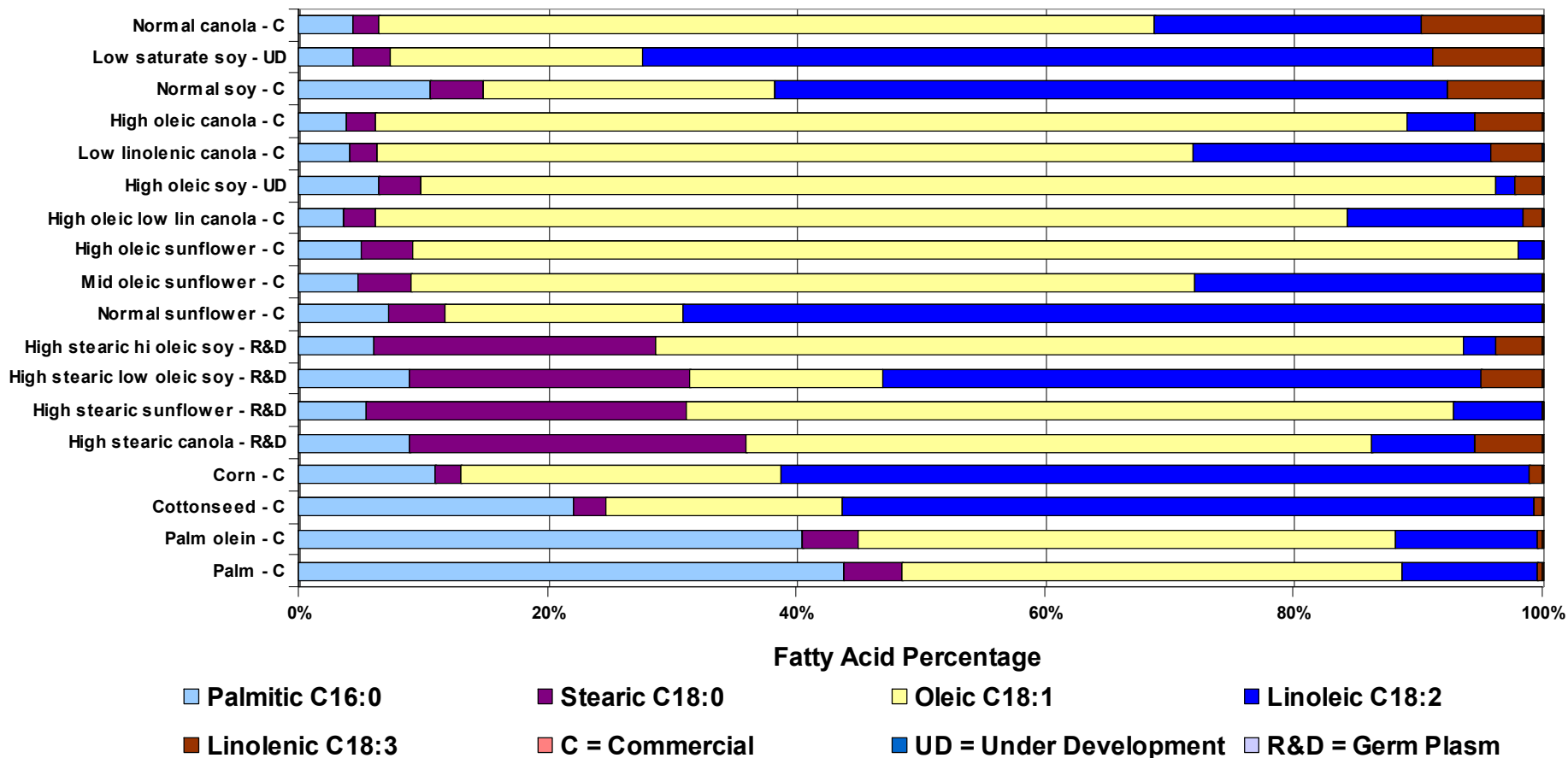
Occurrence of Trans Fats in Foods

- **Innies *et al* of University of British Columbia, 1999**
 - ✓ 200 foods in Vancouver grocery and food service establishments
 - ✓ TFA ranged from zero to over 60% of the fat in some foods
 - ✓ Margarine, convenience foods and baked goods made with shortening showed highest levels of trans fats
 - ✓ Hard margarine followed by soft margarine contained the highest levels of trans fats as a % of the total food product
- **Industry making significant progress to reduce trans fats**
 - ✓ USDA 2004 report of changes in TFA for selected snack foods
 - ✓ Analysis underway for other foods by USDA and Canada
 - ✓ Many food labels in 2005 in Canada declare lower to zero levels of TFA compared to Innies 1999 study
 - ✓ TFA in hard margarine and some processed foods still problems
- **Innies study useful reference, but may not be indicative of TFA in foods in Canada in 2005**

TFA Reduction Methods Available

- **Customization of Crop Varieties**
 - ✓ Genetically modified fatty acid compositions
- **Fatty Acid Modification by Processing**
 - ✓ Adopt existing processes
 - ✓ New Processes
- **Food Formulations**
 - ✓ Re-formulate
 - ✓ Replace fat in existing food products
 - ✓ New food product concepts

Fatty Acid Composition of Vegetables Oils

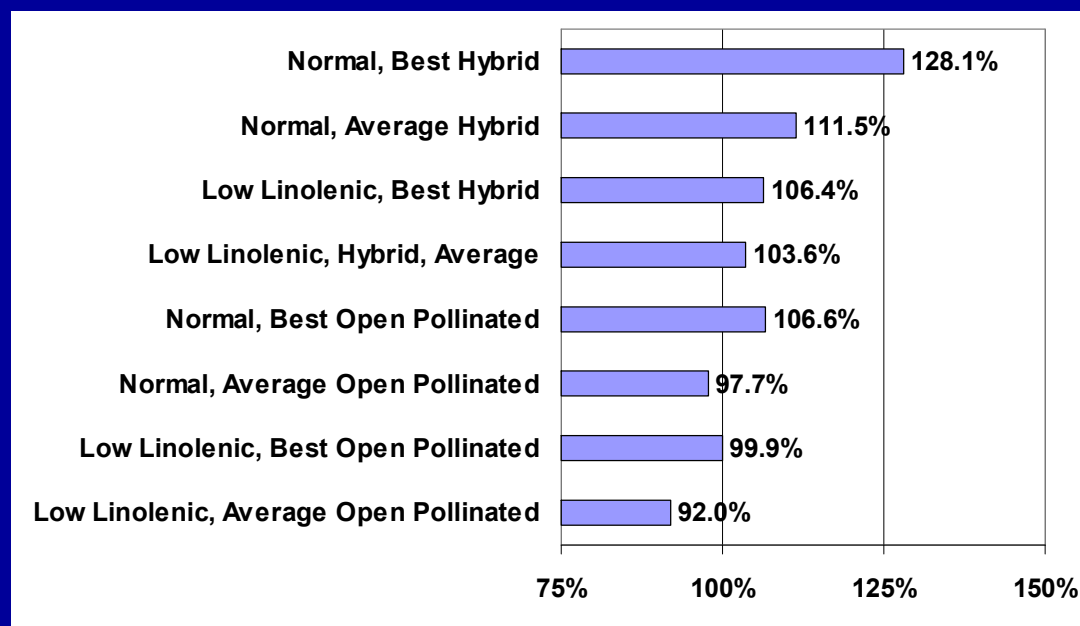


Yield of Canola Varieties & Hybrids

- **Canola farm yields increased 24.5% from 1990 to 2000**
 - ✓ Higher yielding varieties with better disease resistance
 - ✓ Practice change with herbicide resistance (**some GMO**) varieties
 - ✓ Yields now poised for further big increase with hybrids – **GMO**

2004 Prairie Canola Variety Trials

Source: SWP



- **Low linolenic varieties lower yielding than normal canola**
 - ✓ Yield “lag” due to low R&D investment and fewer generations of plant improvement compared to normal canola

Issues re: Specialty Varieties

- **Field performance of new genotypes**
 - ✓ **Never good initially.** Low yields a very significant penalty
 - ✓ Barrier to achieving TFA objective ...?
- **Plant breeding investment**
 - ✓ **Optimal fatty acid composition** – **have to know** which re: C16:0 *versus* C18:0 and ratio of C18 unsaturated fatty acids
 - ✓ **Breeding takes time** – low C18:3 mutation breeding started in early 1970s..... for Canada – C18:0 hasn't started...!!!
 - ✓ **Breeding takes investment \$** - some firms have invested in low linolenic canola since mid-1980s ... & ... **still waiting for payoff**
- **Identity Preserved *versus* Identity Contained**
 - ✓ In absence of agreed standards, must **Identity Contain ... ouch !**
 - ✓ Big costs for IP, bigger for IC, from farm to food manufacturer
 - ✓ Business risks and costs of IP / IC are substantial
 - ✓ All costs are borne by domestic consumer **and** by those selling into export markets – where seller is a **price taker**
 - ✓ Costs of IP / IC cannot be ignored. Need volume to reduce cost
 - ✓ Only so many specialty genotypes are feasible for industry

Fatty Acid Modification by Processing

- **Hydrogenation**
 - ✓ For partial hydro products, **zero trans not possible**
 - ✓ For 100% hydro canola or soybean – **zero trans but high saturate**
- **Blending of basestocks**
 - ✓ Zero or low trans can be produced by blending appropriate stocks
 - ✓ Difficult to get desired melting properties in plastic fat
- **Fractionation**
 - ✓ Widely used in other countries
 - ✓ In palm, results in unsaturated palm olein and saturated fractions with useful melting properties
 - ✓ Process demonstrated with experimental high stearic soybean oil
- **Use of Saturated Fats**
 - ✓ **Domestic** – **fully hydrogenated** C18:0 canola & soybean fats
 - ✓ **Domestic** – animal fats – tallow and lard
 - ✓ Imported – tropical oils and fats – palm, coconut, babasu

Fatty Acid Modification by Processing

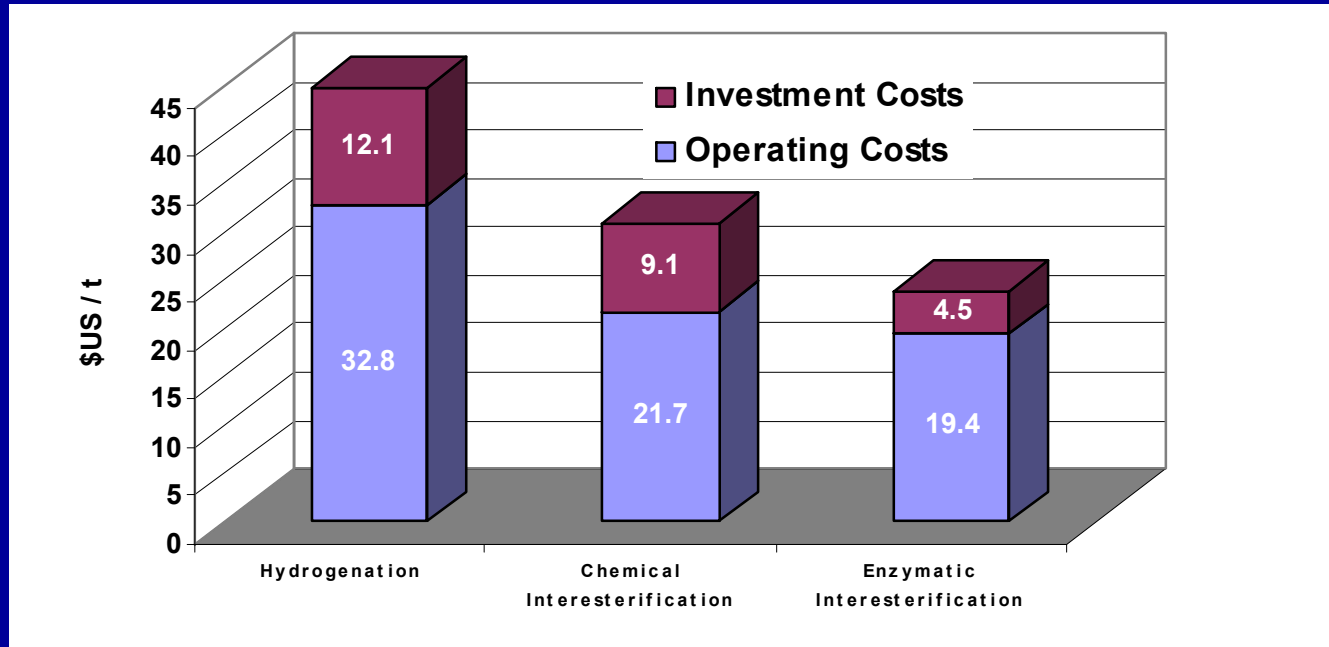
- **Chemical Interesterification**

- ✓ Proven track record in Europe
- ✓ Fatty acids are randomized.
- ✓ Difficult to direct the reaction, but
- ✓ Range of consistencies possible for margarine, shortening and confectionary fats

- **Enzyme-assisted Interesterification**

- ✓ More control than chemical catalysis
- ✓ Enzymes highly specific. React at lower temperatures.
- ✓ Lipolase™ – lipase gene from *Thermomyces lanuginosus* **cloned** into *Apergillus oryzae*. Enzyme produced by submerged fermentation of a **GMO**.
- ✓ Economics came with immobilization and reuse of enzyme
- ✓ Novozyme / De Smet **framebreaking technology**
- ✓ Expect lower capital and operating costs than hydrogenation and chemical interesterification

Costs of Fatty Acid Modification by Processing



- Source – Novozymes A/S, Denmark & United States
- ADM has the first commercial enzyme interesterification facility in North America at Quincy, Illinois.
- ADM's NovaLipid™ product line includes - naturally stable oils, fully hydrogenated soybean fats, tropical oils, blended oils and interesterified shortenings and margarines
- USDA – if > 20% stearate, label may state “high stearate” or “stearic rich” interesterified soybean oil

Food Reformulation – Fat Replacers

- **Reformulate foods**

- ✓ Reduce TFA by reducing total fat in food
- ✓ **Important option if industry must also reduce saturated fat**

- **Lipid-based fat replacers**

- ✓ Emulsifiers – alter functionality of fats. Reduce fat content.
- ✓ Diacylglycerols – ADM/Kao Corporation. May help address obesity.
- ✓ Medium chain triglycerides – modest reduction in calories.
- ✓ Salatrim or Benefat™ – short & long chain triglycerides. ~1/2 calories
- ✓ Olestra™ – fatty acids on sucrose backbone. Not digested. GI issues.

- **Carbohydrate-based fat replacers**

- ✓ Mimic properties of fats.
- ✓ Bind water, contribute bulk, mouth feel and lubricity similar to fat
- ✓ Many types – starches, maltodextrin, polydextrose, inulin, hydrocolloid gums, fibres

- **Protein-based fat replacers**

- ✓ Simplese™ – microparticulated protein
- ✓ Provide smooth and slippery mouth feel in high moisture foods
- ✓ Not suitable for frying because of heat susceptibility

Initiatives to Reduce Trans Fat

- **Investment**

- ✓ Solutions require \$ for replacement technologies and new products, both calling for R&D and demonstration
- ✓ Make or buy ...? Which best for Canada ...?
- ✓ **Suggest - place R&D and D \$ for competitive advantage**

- **Public awareness and education – fats & oils**

- ✓ Public increasingly aware of trans fats
- ✓ Public not aware plastic fats require saturated or trans fats for physical / chemical properties
- ✓ **Education about saturated fats – acceptable at some level?**

- **Health benefits of low / zero trans fat products**

- ✓ With low / zero trans, expect increased use of tropical oils and soy / canola stearines (fully hydrogenated C18:0)
- ✓ Is obesity mitigation a bigger issue than trans fats?
- ✓ **Present TFA strategies not addressing caloric intake**

Change Fats & Oils - Timeframe

- **Retail salad & cooking oils, salad dressings**

- ✓ Canola, soybean & sunflower extracted oils **naturally low trans**
- ✓ Small amount of trans produced during deodorization.
- ✓ More trans if “brush” hydrogenated – soybean.
- ✓ Low linolenic canola **available today**, but no advantage at retail

- **Margarines and spreads**

- ✓ Soft margarines – low trans **available today**. Big range in polyunsaturated fatty acid composition
- ✓ Hard margarines – still high trans. **Low trans possible** if processors ignore functionality and cost. New products in 1 – 3 year pipeline, but containing high C16:0 and/or C18:0

- **Frying oil – food service and quick service**

- ✓ Heavy duty frying requires stable fats
- ✓ Low linolenic / high oleic canola & sunflower **being adopted**, but at higher cost and some reduced functionality /sensory properties
- ✓ Low linolenic soybean entering US pipeline. **Not yet in Canada**
- ✓ Dupont high oleic soybean **trait approved** in Canada
- ✓ 1 – 3 years for product development with existing oils
- ✓ 4 – 8 years for low linolenic soybean oil.

Change Fats & Oils - Timeframe

- **Industrial frying and food processing**

- ✓ Low linolenic / high oleic canola and sunflower **available today** for snack frying, with acceptable functionality and sensory properties
- ✓ Potato chips, tortilla chips, frozen french fries, etc. converting to low trans. See USDA 2004 report.
- ✓ Doughnut frying and spray oils – **challenge for functionality.**
- ✓ 1 – 3 years for product development with existing oils
- ✓ 4 – 8 years for low linolenic soybean oil.

- **Baking shortenings**

- ✓ Wide range of product specific functionalities
- ✓ Partial hydro & tropical oils used with trans & saturate fat content
- ✓ Fractionated and interesterified fractions are possible replacements for trans
- ✓ **Formulation challenge** for low trans replacements for All Purpose Shortening, Emulsified Shortenings, Pastry Roll-ins where specific functionalities required.

New Processing Techniques - Timeframe

- **Hydrogenation**
 - ✓ Mature technology. **Available today**
 - ✓ Must use to make fully hydrogenated C18:0
- **Blending**
 - ✓ Mature technology. **Available today**
 - ✓ Relies on imported tropical oil & fully hydro fats
- **Fractionation**
 - ✓ Mature technology. **Investment and learning needed if selected**
 - ✓ Relies on imported tropical oil & fully hydro fats
 - ✓ Use with “high stearic” soybean or canola oils, if become available
- **Chemical Interesterification**
 - ✓ Mature but improving technology. **Investment and learning needed if selected**
 - ✓ Rely on full suite of oils and fats
- **Enzyme Interesterification**
 - ✓ Emerging technology. **Investment and lots of learning needed if selected**
 - ✓ Rely on full suite of oils and fats
 - ✓ Technology of choice to reduce or eliminate trans fat
 - ✓ **Many product potentials in addition to trans fat mitigation**

New Genetics - Timeframe

- **Low linolenic / high oleic genotypes**
 - ✓ Canola. Yield improvements essential. **Available today from Canadian production.**
 - ✓ Sunflower. Canadian production possible. Available from US production.
 - ✓ Soybean. Only now entering US pipeline. Canadian production possible with focused effort in 4 – 8 years.
- **High stearic canola / soybean**
 - ✓ Emerging technology.
 - ✓ Substantial and accelerated investment in plant breeding needed to realize commercial varieties in 8 years.

Regulation

- **Principal areas**

- ✓ Novel foods – Health Canada
- ✓ Novel plant traits – Plant Biosafety Office, CFIA
- ✓ Variety registration – Seed Section, Plant Product Division

- **Impacts**

- ✓ Generally strong support of consumers and industry
- ✓ But, with impacts on innovation and investment attraction
- ✓ Facilitative role by lead agencies might help advance solutions quickly re: trans fats mitigation

Innovation Opportunities

- **Fat replacement**
 - ✓ Emulsifiers key ingredient
- **Nutraceutical lipids**
 - ✓ Structured lipids by interesterification
- **Membrane technologies**
 - ✓ Novel processing for fat conversion
 - ✓ Squeeze cost out of processing
- **Novel Hydrogenation**
 - ✓ Electrochemical
 - ✓ Enzyme-assisted
- **New Types of Food Products**
 - ✓ Novel thermal processes to replace traditional cooking, frying & baking
 - ✓ Replace traditional products

Closing Remarks

- **Trans fat reduction objective**
 - ✓ Transforming oil and fat chemistry and processing
 - ✓ No drop-in solutions that apply across the board
 - ✓ Transformational change must be systemic
 - ✓ Solutions at different levels involving multitude of players
 - ✓ Need support of consumers
- **Progress**
 - ✓ Good progress being made by industry
 - ✓ Challenges remain
 - ✓ Investment needed in technology, R&D & learning
- **Technical Solutions**
 - ✓ Involve mutation and transgenic plant breeding, with
 - ✓ Transgenic enzyme production, with
 - ✓ Innovative process engineering, with
 - ✓ Innovative food science and food product development
 - ✓ Potentials beyond trans fat
- **Nutrition Targets**
 - ✓ Validation important -
 - ✓ Maintain consumer support, and
 - ✓ Continue to attract investment