DOUGLAS CHAPMAN
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What In The World Is Going On with Fats?

PRESENTED BY:

DOUGLAS CHAPMAN

TO

WOMEN IN FOOD INDUSTRY MANAGEMENT

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Agenda

Part 1:

- Introduction
- Terminology
  - Fat vs Oil
  - Saturated, Unsaturated, Polyunsaturated
  - Cis versus Trans
  - Omega-3's, 6,9
  - Hydrogenation, Interesterification

Part 2:

- Functionality: What do fats do?
- Label Claims: Growth, Believability
- Trans fats
- Saturated fats
- Tropical oils Issue (1989)
- Omega 3's, (plus 6 & 9)
- Close

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Chicken Fried Bacon

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Donut Burger

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Terminology: Fats vs Oils

- Fats are solid at room temperature, oils are liquid
  - The key is the environmental temperature the source organism experiences
  - Forget all the references to fats being of animal origin and oils being of plant origin – there are too many exceptions
    - Solid vegetable oils: coconut, palm, palm kernel, shea, illipe
    - Liquid animal fats: Fish and marine oils generally

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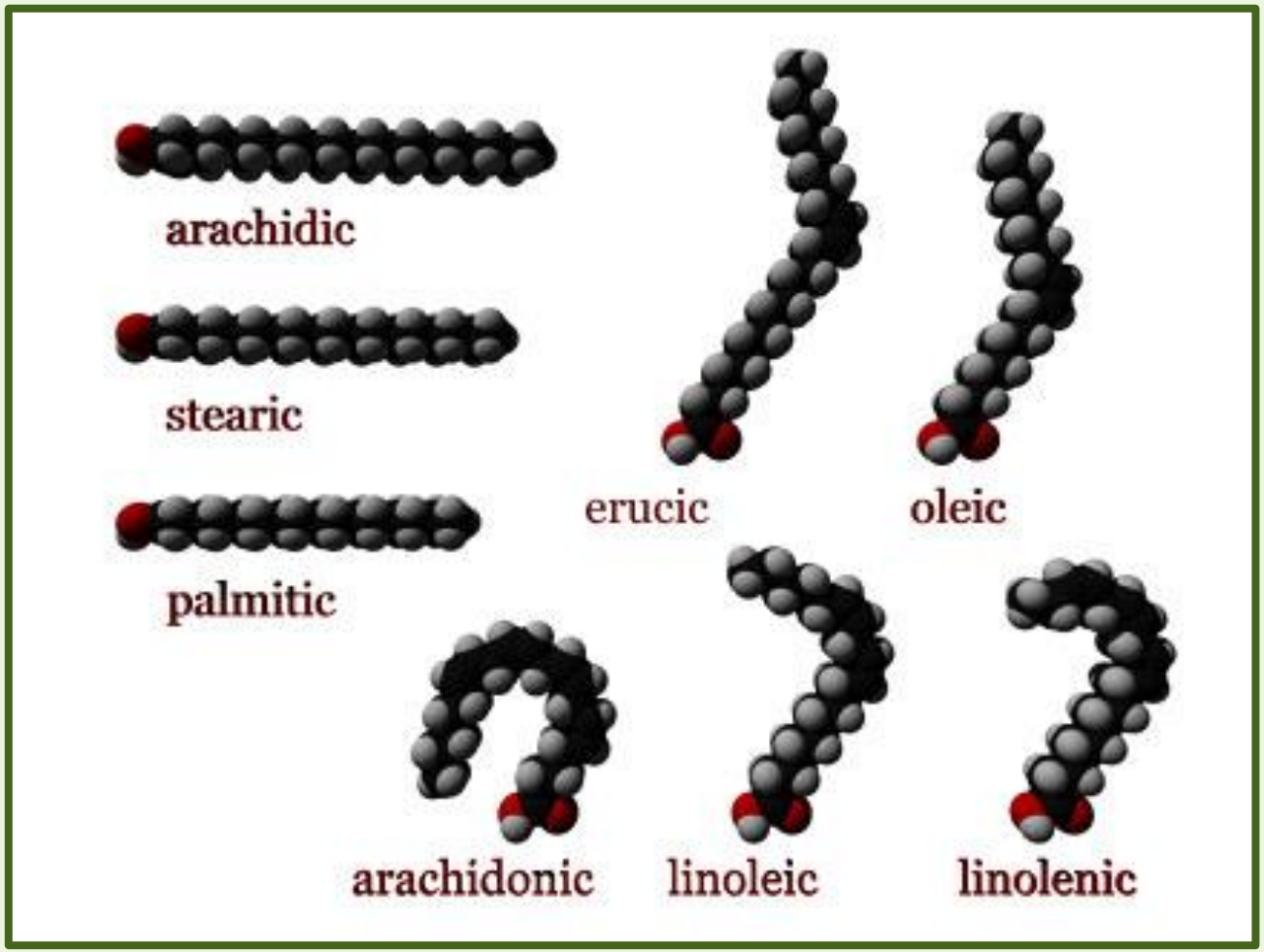
Fatty Acids: SFA, MUFA, PUFA



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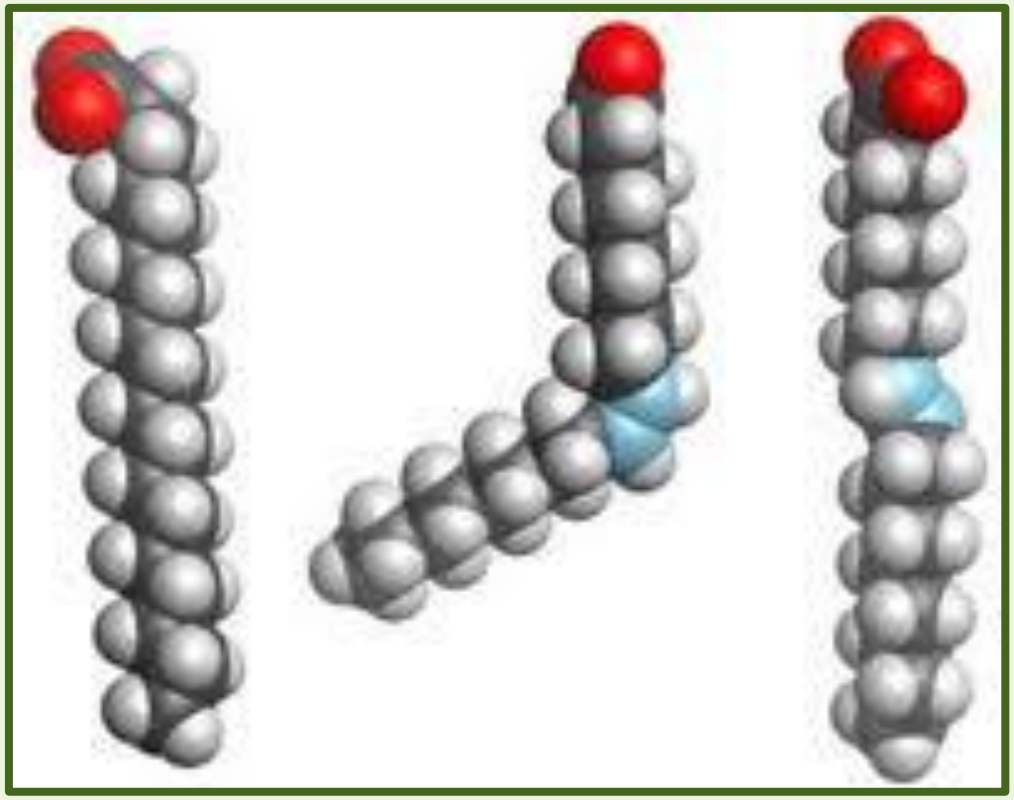
Cis versus Trans



Saturated Cis Trans

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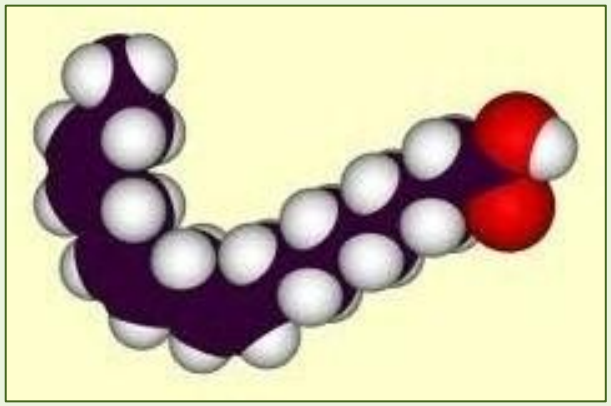
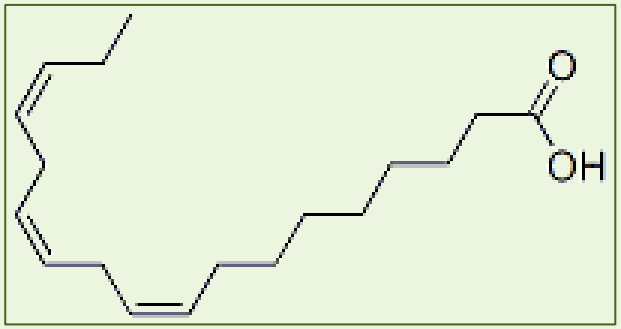
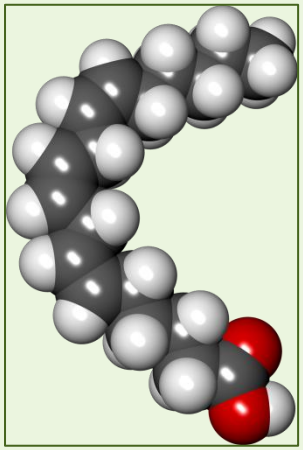
Omega – 3's

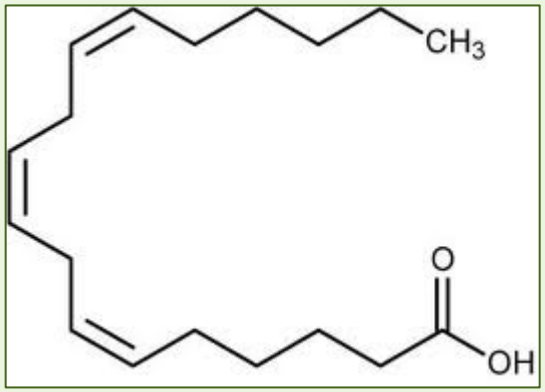


Alpha Linolenic Acid
(18:3n3)





Gamma linolenic Acid
(18:3n6)



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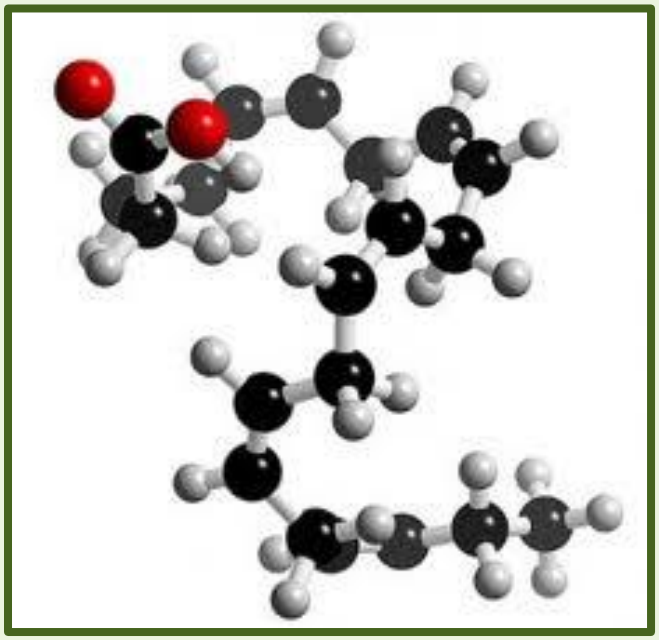
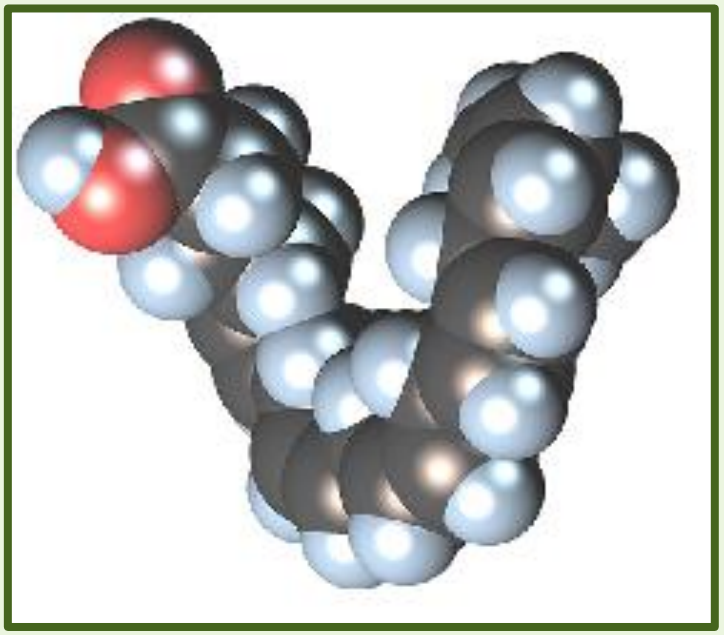
More Omega-3's





EPA (Eicosapentaenoic Acid)
(20:5n3)

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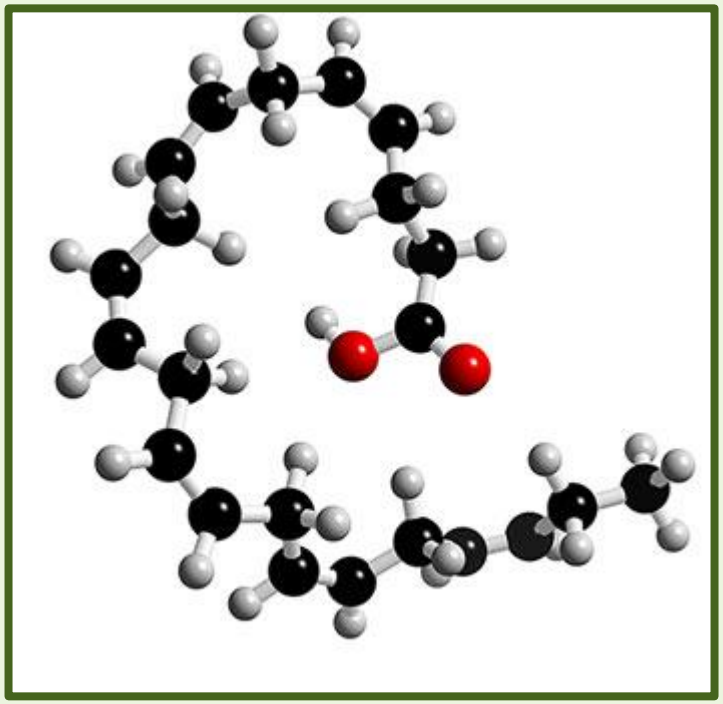
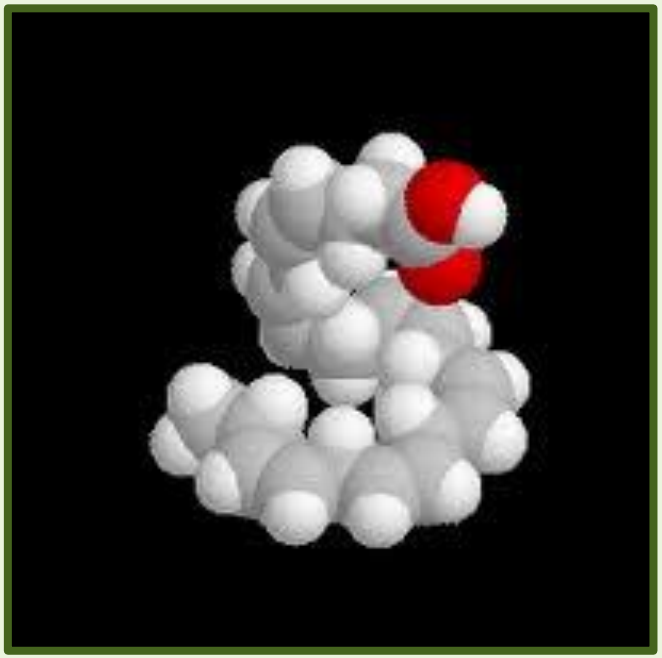
More Omega-3's





DHA (Docosahexaenoic Acid)
(22:6n3)

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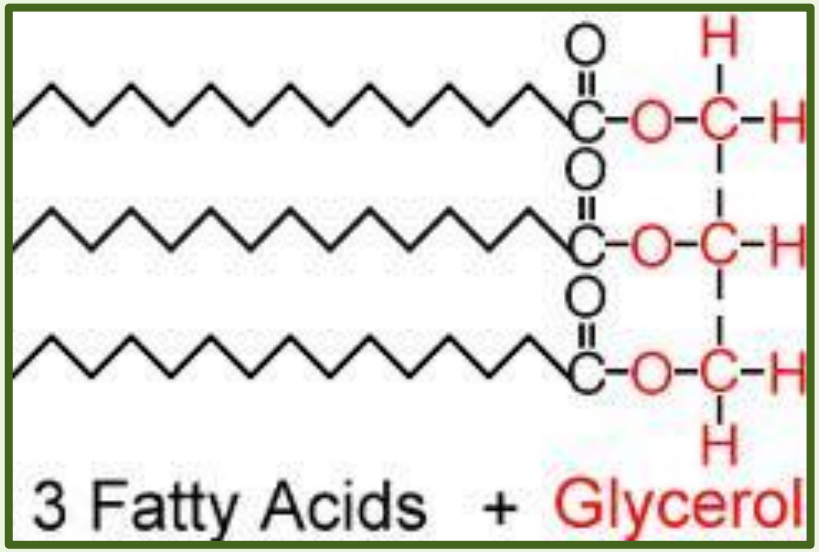
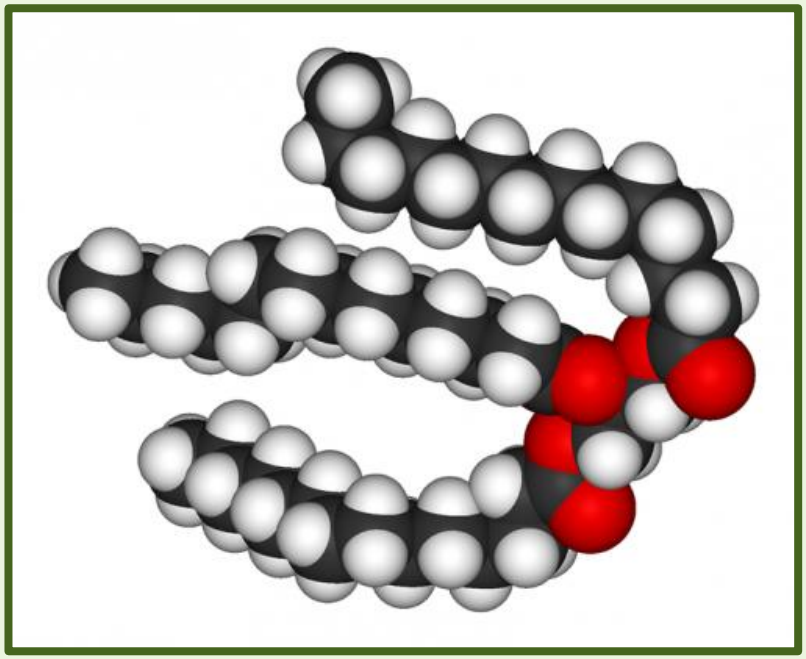
Triglycerides





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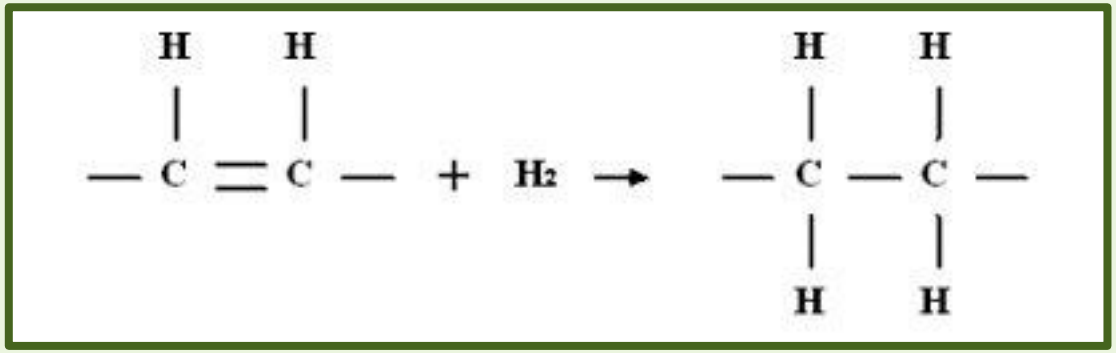
Hydrogenation



- If the substrate is polyunsaturated and if the reaction is only partially completed:
  - The products are saturated single bonds, unsaturated Cis, unsaturated Trans
  - The reaction favours the formation of Trans

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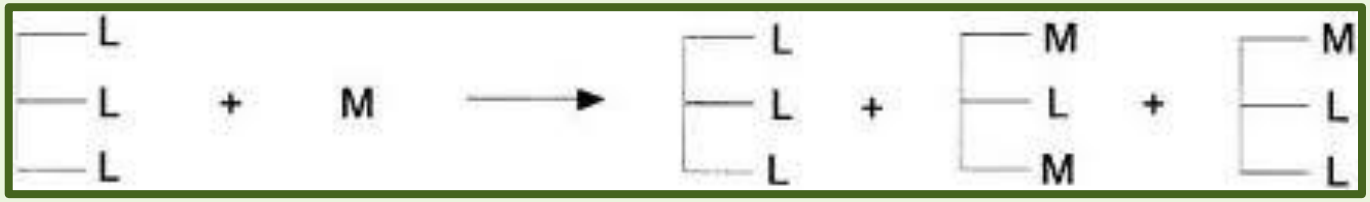
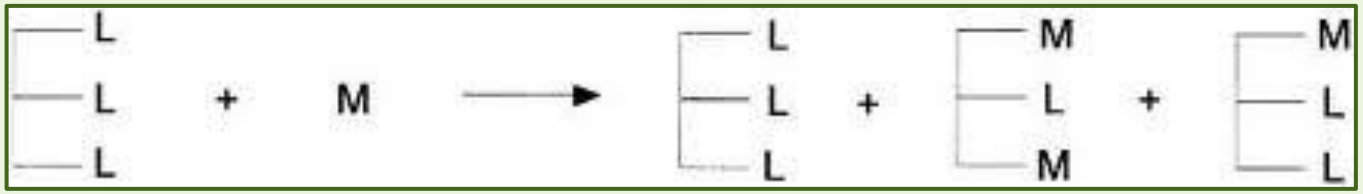
Interesterification

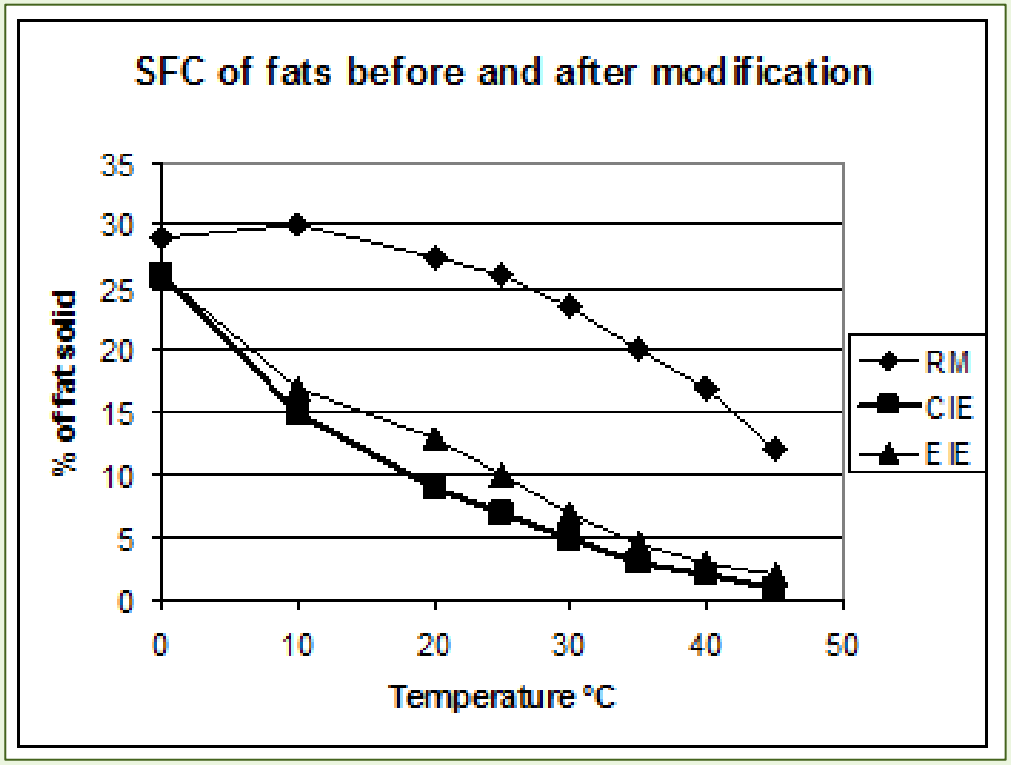


Randomize fatty acids on the glycerol positions

Enzymatic Interesterification, lipidlibrary.aocs.org

Interesterification





75% soybean oil
25% fully hydro soybean oil

Enzymatic Interesterification, lipidlibrary.aocs.org

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Functionality: What Do Fats Do?

- Nutrition:
  - 9 cal/g
  - Carry vitamins A,D,E,K
  - EFA: Linoleic acid, Linolenic Acid
- Aeration
- Shortening

- Heat transfer
- Flavour
- Lubrication
- Glaze, Gloss
- Satiety
- Emulsions
- Melting Characteristics
- Textural Effects

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Health Claim Growth (USA)

Health Claim	% $ Sales growth YOY
Omega	42
Antioxidant	29
Gluten Free	16
Probiotic	13
Calcium	13
Fibre	13
Low glycemic	12

The Neilsen Company, Neilsen Strategic Planner, 52 Weeks ending 12/27/09

Health Claim Believability

	%
• Believe health claims on labels	53
• Do not believe	47
• Believe probiotics improve health	72
• Omega-3 fatty acids make foods healthier	79

Ipsos Reid for Global National and PostMedia News
Jan 18, 2011 United Press International, Inc.

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Trans Fats

- 30 years ago, when I joined the industry Trans Fats were viewed favourably!
  - Improved stability – takes longer for off flavours to develop: frying applications, long shelf life products
  - Softer than saturates, but not liquid oil
  - Useful in plastic, malleable products
  - Excellent functionality in shortenings and margarines
  - Hydrogenation conditions could be adjusted to raise or lower the level of trans fats and fine tune functionality

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What Happened?

Weight of science turned:

- Mensink and Katan 1990:
  - Showed for the first time trans fats raise LDL cholesterol and lower HDL cholesterol
  - N Engl J Med. 1990 Aug 16;323(7):439-45.

- Negative health consequences related to trans fats:
  - Increase low-density lipoproteins
  - Associated with increased inflammation of the arteries
  - Make cell membranes “leaky” to calcium

“Inflammation, high LDL cholesterol and calcified arteries are the signature ingredients of atherosclerosis.”

F. A. Kummerow, Atherosclerosis vol. 205, pp 458-465, August 2009

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Removing Trans Fats

Focus has turned to removing Trans Fats from foods

<u>Frying and Soft Oil Applications</u>

- Replace with “modified oils” – plant breeding
  - High oleic oils: canola, sunflower (Omega-9’s)
  - High oleic, Low linolenic soy

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Margarine, Shortening, Bakery

- Partial Hydrogenation no longer used - need a source of solid fats
- Go to the hardest, most saturated fats known and use the smallest amount possible
- Leads to palm, palm kernel and coconut oils or fully hydrogenated vegetable oils or saturated diglyceride hard stocks or high stearic soybean oil (in approval process)
  - Will saturates go up? YES
  - Will saturates + trans go up? NO
  - Can difficult bakery applications be met? YES
- Barriers to Trans removal: No universal solutions, Cost

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Saturated Fat World Has Changed!

- Historically SFA & increased risk of CHD were synonymous
- March 2010: The American Journal of Clinical Nutrition published the results of a meta-analysis:
  - 21 separate studies, 347,747 subjects
- Conclusion: *"There is no significant evidence for concluding that dietary saturated fat is associated with an increased risk of CHD or CVD. More data are needed to elucidate whether CVD risks are likely to be influenced by the specific nutrients used to replace saturated fat."*

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Saturated Fat World Has Changed!

- April 2011: Expert panel reviewed the evidence and published its recommendations (Am J Clin Nutr 2011: 684-8)

"Substituting polyunsaturated fatty acids (PUFAs) for SFAs is associated with lower CHD risk; substituting total carbohydrate for SFAs is associated with no or a moderately higher risk of CHD."

- Advice: If you replace SFAs do it with polyunsaturated fats not high glycemic carbohydrates or you could increase the risk of CHD!

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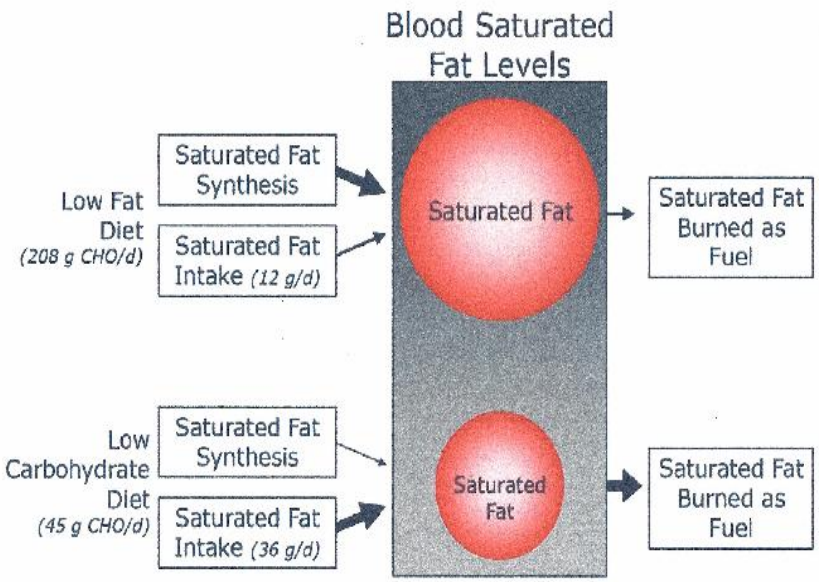
Blood SFA Levels



J.S. Volk, Human Performance Laboratory, U Conn

Replace SFA with Carbohydrate:

Low Dietary SFA :
Body synthesizes SFA
Excess dietary carbohydrate preferentially burned for energy!

SFA accumulates!

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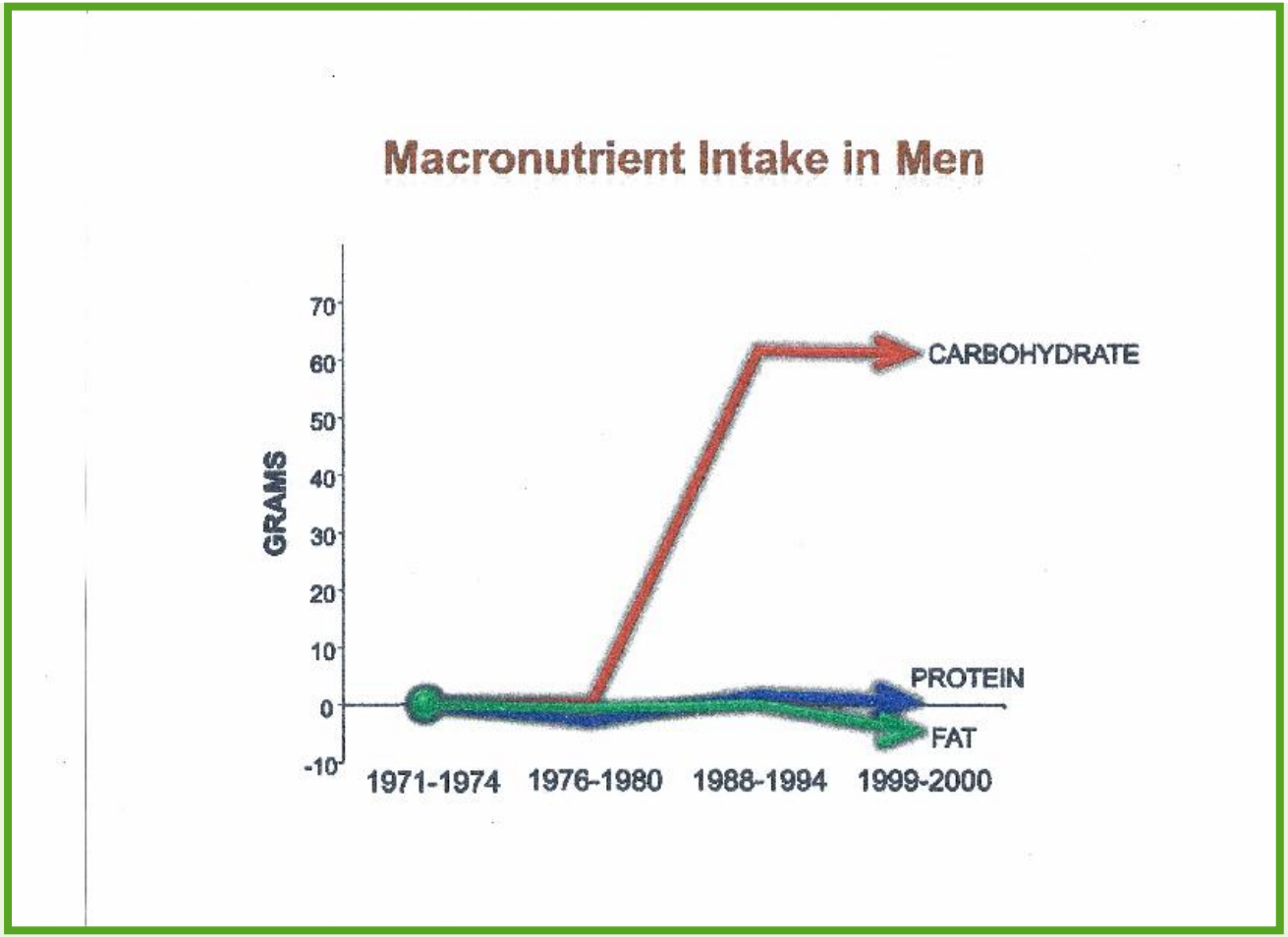
Macronutrients



J.S. Volk, Human Performance Laboratory, U Conn

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SFA/Trans: Tropical Oil Issue

- LA Times article dated Jan 22, 1989.
- National Heart Savers Association took out full page ads claiming companies were poisoning consumers by using palm and coconut oils
- US food industry driven to replace “tropical oils” with “vegetable oils containing unsaturated fatty acids”
- Soy industry took out ads in trade literature citing dangers of oils high in saturated fats
- Consequences?

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Removing Saturates

- Lower total fat
- Continue with very saturated fats at lower levels
- Investigate SOS triglycerides – expensive!
- Investigate saturated diglycerides
- Emulsions
  - Surface gives structure
  - w/o: margarine, bakery emulsions
  - o/w: monoglyceride gel or starch stabilized

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Omega-3 Benefits

- Dietary Omega-3s, reduce risk:
  - CVD, myocardial infarction, sudden cardiac death
- DHA : visual & neurological development
- Low DHA: risk factor Alzheimer's
- Increased EPA & DHA: benefits type 2 diabetes
- Fish oil: benefits rheumatoid arthritis
- May be beneficial for depression, bipolar disorder & schizophrenia
- Fish oil supplements may block chemotherapy benefits!

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Omega-3 Market

- Revenue $US 1.482 billion in 2010
- Compound growth estimated at 13.8% 2011-2016
- Asia Pacific: 34% share, 15.2% growth
- Supplements: 65% of total market
- Food & Beverage: 26.2% growth 2011-2016
- Marine Oil: 85% share with 14.3% growth

Nutraingredients.com quoting Omega 3&6 Market by Source, Application, Geography, Trends & Global Forecasts (2011-2016) Markets and Markets

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Markets continued

- "While consumer awareness and sales of functional foods and beverages continue to grow, the number of Americans who report that they consume such foods has shown virtually no increase since 2005."
  - "Functional Foods: Consumption Lags Awareness", Marketing Daily Aug 11, 2011

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Reasons for Consumption Lag

- Expense
- Taste
- Availability
- Convenience
- Knowledge of foods and their desired health benefits
- Confusion over conflicting information
- Insufficient confidence in the science
- Lack of knowledge of how much to consume
- Uncertainty about how to prepare
- Lack of desire to try new foods
- Time to learn about new foods

"Functional Foods: Consumption Lags Awareness", Marketing Daily Aug 11, 2011

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Foods Fortified with Omega-3s

- Infant formula
- Margarine
- Supplements
- Popcorn
- Peanut butter
- Cookies
- Nutrition Bars
- Fish Sticks
- Salad dressing
- Dark chocolate
- Tortillas
- Beverages/juice/smoothies
- Bread
- Milk
- Pork
- Eggs
- Snacks
- Shakes
- Yogurt
- Soup
- Bagels
- Sausage

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Dietary Sources of Omega -3

- Cold water fish: herring, anchovy, salmon, tuna
  - EPA, DHA
- Dark green vegetables: kale, spinach, collard greens
  - ALA
- Nuts: walnuts, pecans
  - ALA
- Vegetable oils: canola, soybean, flaxseed
  - ALA

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Sources of Omega-3s as Ingredients

Animal Sources

- Marine oil: EPA, DHA
  - Fish oil or encapsulated fish oil
- Krill Oil: EPA, DHA
  - Occur as phospholipids
  - Strong antioxidant present

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Sources of Omega-3s

Plant Sources

- Algae: mostly DHA from industrial bioreactors
  - Algae: 2011-2012, open ponds Australia, Arizona
- Higher Plants: seeds, seed oils, nuts, greens: ALA
- Dried, Ingrained Flax: ALA, DHA, EPA
- GM Soybeans: Stearidonic Acid (18:4n3)
- Plant breeding: high oleic canola (omega-9)

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Practical Challenges

- Omega-3s are highly unsaturated and subject to oxidation and off flavour development
- They need protection!
  - Antioxidants
  - Other ingredients esp. absence of oxidation promoters
  - Emulsions
  - Processing requirements – (gentle is better)
  - Shelf life requirements (short is good)
  - Refrigerated/frozen distribution
  - Modified atmosphere packaging
- Cost: $10/kg to 150/kg

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In Conclusion

If the Omega-3 route seems excessively challenging but you are still interested in CHD risk improvement:

An option exists:

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Eat Chocolate!

The British Medical Journal reports that chocolate consumption seems to be associated with a substantial reduction in the risk of cardiometabolic disorders.

BMJ 2011; 343:4488

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Thank You!