Fitting Dietary Fat Into Your Genes
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Outline

I. History (abridged) of the Study of Genetics and Nutrition
II. “The Skinny” on Fats & Genes
III. How Dietary Fats Work with Your Genetic Code for Health
IV. Fitting Genetics and Fats into your Conversation with Patients and Clients
Making History Together -

I. Sciences of Nutrition and Genetics

- 1865 – Mendel ‘Experiments with Plant Hybrids’
- 1930’s & 1940’s – Golden Era of Nutrition
  - Structures of Vitamins Discovered
- 1953 – ‘Era of Molecular Biology’
  - Watson & Crick discover the structure of DNA
- 1970’s – Fatty acids & eicosanoids were linked with biological activities
- 2000 – Human Genome Unraveled
- 2004 – Post Genomic Era
- 2005 – Metabolomics
- 2009 – Lipidomics

II. The Skinny on Lipids

- Fats & Oils
- 9 kcal/g
- Removed, if fat fraction is removed
- Types
  - Fatty Acids
  - Sterols
  - Fat Soluble Vitamins and Other Bioactive Compounds
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Saturated fat

H H H H H H H H H H H H H H H H H H H O
H-C-C-C-C-C-C-C-C-C-C-C-C-C-C-C-C-C-C-OH
H H H H H H H H H H H H H H H H H H H

n3 polyunsaturated fats

H H H H H H H H H H H H H H H H H H H O
H-C-C-C=C=C-C=C=C-C=C-C-C-C=C-C=C-OH
H H H H H H H H H H H H H H H H H H H

α-Linolenic Acid

- Neuronal development and conditions
- Visual Health
- Appetite
- Inflammatory-related diseases
Alpha-linolenic acid (A-LNA; 18:3n3)

Eicosapentaenoic acid (EPA; 20:5n3)

Docosahexaenoic acid (DHA; 22:6n3)

n6 polyunsaturated fat

- Linoleic acid (octadecadienoic acid)
Linoleic Acid

- n6 PUFA
- Essential for growth
- Cardioprotective
- Other effects (?)
- Oils such as corn, safflower, sunflower, soybean

Sterols

"The cracks can be fixed—it's your cholesterol level that worries me."
III. How Fats Work with Your Genetic Code

1. DNA → Transcription
2. mRNA → Translation
3. Protein → Post-Translational Modification
4. Activity
Polymorphism

- Having trait of several possible alleles that are
  - Not fatal
  - Usually exhibited as different *phenotypes*

- Single nucleotide polymorphism (SNP)
  - ‘Snip’
  - One nucleotide is altered in DNA coding for mRNA & protein

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Dietary Fats and Gene Expression

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DNA → Transcription → mRNA → Translation → Protein → Post-Translational Modification → Activity
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Nuclear Hormone Receptors as Transcription Factors

- Require Ligand
- Associate with Response Element (RE)
- Dimerizes with another Nuclear Receptor
  - (requires another molecule of estrogen or estrogen-like compound?)
- ‘Turn on’ Responsive Genes

Peroxisome Proliferator-Activated Receptors

Target Genes code for proteins for metabolism of fat, glucose, and protein
PPARs - A Link Between Fats and Genes

- Diabetes (Thiazolidinediones, TZDs)
  - Avandia, Actos, [Rezulin]
- Cardiovascular Disease
  - Fibrates
- Adipose Tissue Development
- Cancers of breast, colon, skin, others

Dietary Fats and Gene Expression

\[
\text{DNA} \xrightarrow{\text{Transcription}} \text{mRNA} \xrightarrow{\text{Translation}} \text{Protein} \xrightarrow{\text{Post-Translational Modification}} \text{Activity}
\]
Safflower oil increases a plasma protein, adiponectin

Norris et al., 2009; Asp et al., 2011

Dietary Fats and Gene Expression

DNA → Transcription → mRNA → Translation → Protein → Post-Translational Modification → Activity
Metabolism of Estrogen

Lipids Affect **Activity** of Enzyme that Makes Estrogen

Chen et al., Cancer Res 2006
Summary: How Dietary Fats Affect Health by Modifying Gene Expression

1. Modify Molecular Events
2. Reduce Mediators of Inflammation
3. Change the metabolism of other compounds

DNA  \[\rightarrow\]  mRNA  \[\rightarrow\]  Protein  \[\rightarrow\]  Activity

IV. Fitting in Fats: Bringing the genetic link into your dietetics practice
De-Clutter --- Consistent, Specific & Measurable

1. Keep it simple
   (or “Lighten” Up)
2. Keep a Sense of Humor
3. Dive in to the Science---

Keeping Messages Simple

Health

Genetics
(Heredity)

Disease

Diet
(Environment)
Keep Messages Simple

Analogies…

Genetics (your inheritance)
Is Your Map

Keep a Sense of Humor

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Docosahexaenoic acid (DHA; 22:6n3)
Eicosapentaenoic acid (EPA; 20:5n3)
De-Clutter --- Consistent, Specific & Measurable

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Research is the root of nutritional science and practice.
We dietitians are the messengers.

Thank You

- National Cattleman’s Beef Association
- Research Organizations: American Institute of Cancer Research, American Cancer Society
- Carol S. Kennedy Professorship
- Federal Government Research Agencies for Nutrition (USDA & NIH)
- Lab people and collaborators, past and present