Chapter 2 – ANIMAL PRODUCTS IN THE HUMAN DIET
ANIMAL PRODUCTS IN THE HUMAN DIET

Learning Objectives:

1) To discuss the contributions of animal protein sources (meat, milk and eggs) in the human diet.

2) To discuss the causes of the major diseases of Western civilization that are linked to diet and consumption of animal products.

3) To discuss the impacts of ongoing changes in the Western diet on the livestock industries and possibilities for minimizing animal industry disruptions.

(Article 1, 2)
Chapter Outline:

I. WHAT KIND OF ANIMAL ARE WE?
II. NUTRITIONAL PROPERTIES OF ANIMAL PRODUCTS
   A. MILK AND EGGS
   B. MEAT
III. CONCERNS ABOUT RED MEAT AND HUMAN HEALTH
IV. DIET AND CORONARY HEALTH DISEASE
V. MEAT, DIETARY FAT, AND CANCER
VI. OBESITY AND CONSUMPTION OF ANIMAL PRODUCTS
VII. MODIFICATION OF ANIMAL PRODUCTS TO IMPROVE HUMAN HEALTH
VIII. UNDERNUTRITION, SUPERNUTRITION, AND LONGEVITY
IX. VEGETARIANISM
X. CONCLUSIONS
I. WHAT KIND OF ANIMAL ARE WE?

Facts:

A) Humans today are the same basic animal as our hunter-gatherer ancestors (healthier bodies)

B) Dietary habits reflect taste preference, teeth, and digestive tract

- Omnivores are adapted to Paleo diet:
  1. Nutrient-rich, low fiber seeds, nuts, fruits and meat (cannot digest fiber). Diet consists of: a) low saturated fats, 2) lean meat, 3) high cholesterol intake but low serum cholesterol due to high ratio of polyunsaturated to saturated fatty acids, 4) Low cereal grain but high intake of fruits and vegetables (high fiber, more vitamins/minerals and health promoting compounds (phytochemicals)).
  2. Some ancient cultures consume meat and(or) animal food products entirely (Eskimos and Masia).
  3. Vegetarianism (define) is a recent development
  4. B12 – “animal protein factor”, can now be synthesized. (Vegan parents trial article)
I. WHAT KIND OF
ANIMAL ARE WE?

Issues:

A) It is possible to have a healthy
diet without meat; however,
meat is associated with good
health and longevity.

B) Is it ethical to raise animals for
food?

C) Modern humans demand high
energy (sweets, carbs, and
saturated fats) that were far
less abundant before the
agricultural revolution.

Livestock producers should not operate
from the viewpoint that the general
public has an obligation to buy their
products.
II. NUTRITIONAL PROPERTIES OF ANIMAL PRODUCTS (MILK AND EGGS)

Facts:
A) Milk and eggs – sole food for young animals
B) Eggs are high in cholesterol, but can be counteracted by supplemental omega-3 fatty acids (no clear evidence that eating eggs increases risk of CHD)
C) Milk contains lactose – “lactose intolerance”
D) Cow’s milk similar in chemical composition to human milk
E) Dairy products among best sources of calcium
F) Fermented dairy products and animal food products (AFP) produced from animals consuming grass contain high levels of CLA’s (mixture of unsaturated fatty acids, a potent inhibitor of cancer due possibly to its role as an antioxidant)

Issues:
A) Excess of protein from AFP may contribute to osteoporosis?
B) Substitution of milk with soy milk (phytates decrease calcium absorption)
II. NUTRITIONAL PROPERTIES OF ANIMAL PRODUCTS (MEAT)

Facts:
A) Meat – mostly protein and water, almost no carbohydrates, no fiber. Protein is highly digestible
B) Meat – excellent balance of amino acids; however, humans can meet this from wheat and beans
C) Meat - some important minerals (Fe, Zn, Se) and vitamins (B₁, B₂, B₆, and B₁₂). Low in Ca.
D) Liver – rich source of Vitamins A, D, E, and K

NDSU study
II. NUTRITIONAL PROPERTIES OF ANIMAL PRODUCTS (MEAT)

Facts: (Cont.)
E) Association between income and meat consumption
F) Red vs. White Meat Myth (Myoglobin pigment in muscle fibers, mostly found in ruminants)

<table>
<thead>
<tr>
<th>Product</th>
<th>CP, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>10.5%</td>
</tr>
<tr>
<td>Beef</td>
<td>30.7%</td>
</tr>
<tr>
<td>Milk</td>
<td>26.4%</td>
</tr>
<tr>
<td>Eggs</td>
<td>47.0%</td>
</tr>
</tbody>
</table>

Issues:
A) Americans consume 130-200% above NRC requirement for protein; excess excreted as nitrogen – source of pollution!
B) Fat in meat & milk (mostly saturated FA from grain fed animals)
II. NUTRITIONAL PROPERTIES OF ANIMAL PRODUCTS (MEAT)

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- What is a Saturated vs. an Unsaturated fat?
- The rumen has a “Reducing Environment” – what does this mean?
- In ruminant animals, all dietary fats become saturated
- Meat from wild game and grass-fed animals is more lean. The fat is mostly unsaturated (PUFAs, ω-3, and(or) CLAs: “Healthy fat”), and has higher levels of Vitamin A (“yellow fat”) and Vitamin E.

- Question: If all fats in the rumen become saturated then explain why most fat in a grass-fed steer is unsaturated?
<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Sources</th>
<th>Consequences of deficiency</th>
<th>Relevance (groups affected by deficiencies)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>Dairy, liver, fish-liver oil, egg yolk</td>
<td>Growth faltering, impaired development, vision, and immune system, death, maternal mortality</td>
<td>140 million young children, 7 million pregnant women</td>
</tr>
<tr>
<td>Iron</td>
<td>Meats and fish contain heme iron (facilitates non-heme iron absorption)</td>
<td>Young children: impaired growth, cognitive development, and immune function</td>
<td>4 to 5 billion people</td>
</tr>
<tr>
<td>Zinc</td>
<td>Meats and (shell)fish</td>
<td>Pregnancy complications, low birth weight, impaired immune function, maternal and infant mortality and morbidity, growth faltering in infancy and childhood</td>
<td>Estimated as 1 in 2 persons globally being at risk</td>
</tr>
</tbody>
</table>

Table 1. Micronutrients provided by animal-source foods (ASF) (cont.)

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Sources</th>
<th>Consequences of deficiency</th>
<th>Relevance (groups affected by deficiencies)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>Dairy and fish (if consumed with bones)</td>
<td>Nutritional rickets</td>
<td>No global estimates, but rickets seems to be reappearing</td>
</tr>
<tr>
<td>Riboflavin (B$_2$)</td>
<td>Dairy, organ meats, eggs</td>
<td>Stunted growth, skin lesions, soreness and burning of lips, mouth and tongue, burning and itching of eyes, photophobia, corneal vascularization, cheilosis, angular stomatitis, glossitis, anemia, and neuropathy</td>
<td>Good global estimates unavailable (estimated 90% of all adults in China deficient)</td>
</tr>
<tr>
<td>Vitamin B$_{12}$</td>
<td>ASF are only source</td>
<td>Megaloblastic anemia, demyelinating disorder of the central nervous system</td>
<td>Data are not available on global prevalence, but high prevalence of vitamin B$_{12}$ deficiencies reported in many countries</td>
</tr>
</tbody>
</table>

III.-V. MEAT AND HEALTH

Facts: FA composition of wild ruminants
A) Meat is similar to that consumed by our ancestors (“Paleolithic nutrition”): leaner with higher intake of long chain PUFA, which have a lowering effect on serum cholesterol

B) Pre-AG of 1:1 vs. Today of 10-20:1 of ω-6 to. Why is this a problem? Gamey flavor? Benefits of ω-3 (link)

Issues:
A) Some negative effects of PUFA (ω-6 from grains) – may increase risk to certain cancers due to oxidative cell membrane damage (rancidity)
VI-VIII. OBESITY AND ROLE OF NUTRITION

Facts:
A) Largely a disease of Western Civilization
B) Obesity, as well as diabetes, CHD, some cancers (colorectal and prostate cancers from diets high in red meat and fat and low in fiber; lack of exercise)
C) Sugars and oils – easily available (hidden) in highly processed foods

Issues:
A) Supernutrition may accelerate the aging rate process, while Undernutrition may slow down the aging rate process
B) The Mediterranean diet (low incidence of CHD; olive oil is high in monounsaturated fats (MUFA) – serves as an antioxidant)
C) Modification of AFPs – Designer eggs, Grass-fed beef, Fish oil fed to ruminants, Genetic selection (lard- vs. lean-type hogs), Lower fat in animal diets
D) Processed or Salt-cured meats – Nitrites and Nitrates (Dr. Machado’s PPT)

Source: National Geographic
## World's Healthiest Omega-3 Fat Rich Foods

<table>
<thead>
<tr>
<th>Food</th>
<th>Serving Size</th>
<th>Cals</th>
<th>Amount (g)</th>
<th>DV (%)</th>
<th>Nutrient Density</th>
<th>Omega-3 Fat Rich Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flax Seeds, ground</td>
<td>2 tbs</td>
<td>74.8</td>
<td>3.19</td>
<td>132.9</td>
<td>32.0</td>
<td>excellent</td>
</tr>
<tr>
<td>Walnuts</td>
<td>0.25 cup</td>
<td>168.5</td>
<td>2.27</td>
<td>94.6</td>
<td>10.4</td>
<td>excellent</td>
</tr>
<tr>
<td>Salmon</td>
<td>4 oz-wt</td>
<td>244.9</td>
<td>1.47</td>
<td>61.2</td>
<td>4.5</td>
<td>very good</td>
</tr>
<tr>
<td>Sardines</td>
<td>3.20 oz-wt</td>
<td>188.7</td>
<td>1.34</td>
<td>55.8</td>
<td>5.3</td>
<td>very good</td>
</tr>
<tr>
<td>Beef, grass-fed</td>
<td>4 oz</td>
<td>175.0</td>
<td>1.10</td>
<td>45.8</td>
<td>4.7</td>
<td>very good</td>
</tr>
<tr>
<td>Gloves</td>
<td>2 tsp</td>
<td>13.6</td>
<td>0.18</td>
<td>7.5</td>
<td>9.9</td>
<td>very good</td>
</tr>
<tr>
<td>Soybeans</td>
<td>1 cup cooked</td>
<td>297.6</td>
<td>1.03</td>
<td>42.9</td>
<td>2.6</td>
<td>good</td>
</tr>
<tr>
<td>Halibut</td>
<td>4 oz-wt</td>
<td>158.8</td>
<td>0.62</td>
<td>25.8</td>
<td>2.9</td>
<td>good</td>
</tr>
<tr>
<td>Scallops</td>
<td>4 oz-wt</td>
<td>127.0</td>
<td>0.41</td>
<td>17.1</td>
<td>2.4</td>
<td>good</td>
</tr>
<tr>
<td>Shrimp</td>
<td>4 oz-wt</td>
<td>112.3</td>
<td>0.37</td>
<td>15.4</td>
<td>2.5</td>
<td>good</td>
</tr>
<tr>
<td>Tofu</td>
<td>4 oz-wt</td>
<td>86.2</td>
<td>0.36</td>
<td>15.0</td>
<td>3.1</td>
<td>good</td>
</tr>
<tr>
<td>Tuna</td>
<td>4 oz-wt</td>
<td>157.6</td>
<td>0.33</td>
<td>13.8</td>
<td>1.6</td>
<td>good</td>
</tr>
</tbody>
</table>
The Mediterranean Diet

IX. VEGETARIANISM

Facts:
A) In rare human “carnivorous” cultures, there is low incidence of diseases of modern Western Civilization (e.g., Aborigines, Eskimos and Masai). Eskimos consume much fish, high in PUFAs (ω-3) that lowers serum cholesterol level
B) Advantages: low fat/high fiber intake, beneficial role of phytochemicals. What are examples? (Chlorophyll, Saponins, and Tannins lower serum cholesterol, also serve as antioxidants against some cancers)
C) Reducing dietary cholesterol has little effect on serum cholesterol. Good (HDL) vs. bad cholesterol (LDL) (page 49)?

Issues:
A) Is a vegetarian diet adequate for good health and longevity? (soy milk contains phytases - decrease CA absorption)
B) Concerns over Vitamin B₆, B₁₂, Folic acid, Zn, Ca (Nutrients adequately met through supplementation?)
C) Vegetarians tend to be thinner, and smoke/drink less
D) Difficulty of conducting controlled studies. Why?
The Vegan Food Pyramid

Vegetable Oils and Fats
Some sweets, salt, spices, Nuts,
Use Sparingly

Fortified Dairy Substitutes
2-3 Servings
Eat Moderately

Whole Grains, Bread
Rice and Pasta, Cereal Group
6-11 Servings
Eat Generously

The Veggie Group
3-5 Servings
Eat Liberally

Legumes, Seeds
Beans Group
2-3 Servings
Eat Moderately

The Fruit Group
2-4 Servings
Eat Liberally

Water
8-10 Glasses a day. If you are active, drink more!
X. CONCLUSIONS

- **NRC Nutritional Recommendations:**

  1) Decrease total and saturated fat by \( \leq 30 \) and \( \leq 10\% \) of total caloric intake; Decrease cholesterol intake to \(< 300 \text{ mg} \) ([video](https://www.nutrition.com/videos.html))

  2) Eat \( \geq 5 \) servings of fruits & vegetables daily; \( \geq 6 \) serving combinations of breads, cereals, and legumes*

  3) Reasonable or “moderate” amount of protein (no \( > 6 \text{ oz/d} \))

  4) Balance diet with exercise

  5) No alcohol (no \( > 2 \) cans of beers/glasses of wine daily)

  6) Limit salt (no \( > 6 \text{ g/d} \))

  7) Adequate calcium intake (low/no fat milk/other dairy foods)

  8) Avoid dietary supplements in excess of U.S.-R.D.A.

  9) Adequate flouride for strong teeth (especially for children)

* [http://nutrition.about.com/od/fruitsandvegetables/f/servingfruit.htm](http://nutrition.about.com/od/fruitsandvegetables/f/servingfruit.htm)