The Hominin Fossil Record: Plio-Pleistocene Diets

- As many as 20 hominin species may have existed since the evolutionary split between hominins and pongids (5-7 MYA)
- No universal diet existed, but rather varied by ecologic niche, season, geographic locale, availability of edible foods


Plio-Pleistocene Hominin Diet: The Known – An Omnivorous Diet

Minimally Processed, Wild Plants and Animals

!Kung Woman displays fruits of her gathering: tamma melons, grewia berries, tortoise, roots

Plio-Pleistocene Hominin Diet: An Omnivorous Diet – The Evidence

The Diet of Our Closest Living Relatives

Pan troglodytes, Pan paniscus

- Primarily frugivorous
- Diet varies by habitat & season
- ~3-5% animal foods (small vertebrates & insects)
- During the dry season meat intake may reach ~ 65 g/day in adults

Chimp Eating Colobus Monkey

Plio-Pleistocene Hominin Diet: An Omnivorous Diet – The Evidence

Stable Isotopes

It now seems inescapable that all hominid species inhabiting the S. African landscape from the late Pliocene to the early Pleistocene exploited foods of C₄ grass origin and were very likely all omnivorous.


Sponheimer M et al. Science 1999;283:368-70

Beginning at least 2.5 MYA, a number of lines of evidence indicate increasing reliance upon animal foods by some species of hominins.


Plio-Pleistocene Hominin Diet: Increasing Animal Food – The Evidence

Oldowan Lithic Technology First Appears 2.5-2.6 MYA

Oldowan Lithic Technology

First Appears 2.5-2.6 MYA

Semaw S. et al. 2.5-million-year-old stone tools from Gona, Ethiopia. Nature 1997;385:333-6

Semaw S. et al. 2.5-million-year-old stone tools from Gona, Ethiopia. Nature 1997;385:333-6

Plio-Pleistocene Hominin Diet: Increasing Animal Food – The Evidence

Earliest Meat & Marrow Extraction (2.5 MYA)

Hammerstone Percussion Pits

Scanning electron microscopy of a stone cut mark on the medial surface of an Alcelaphine bovid (wildebeest/Hartebeest) mandible made during tongue removal


Plio-Pleistocene Hominin Diet: The Known – Secular Increase in Animal Food

More Animal Food


Semiw S. et al. 2.5-million-year-old stone tools from Gona, Ethiopia. Nature 1997;385:333-6

Plio-Pleistocene Hominin Diet: Increasing Animal Food – The Evidence
The Expensive Tissue Hypothesis

INTERPRETATION:
- Relaxation of selective pressure formerly requiring a large gut caused by:
  - Increase in dietary quality
  - Increase in energy density
  - Decrease in fibrous, high roughage plant foods
  - Increase in animal foods

Plio-Pleistocene Hominin Diet: Increasing Animal Food – The Evidence
Northern Latitude Colonization

Evolutionary Biochemical Adaptations Similar to Carnivores

1. Synthesis of Taurine
   - Cats: Lacking
   - Humans: Inefficient (Semi-conditional)
2. Synthesis of vitamin A from beta carotene
   - Cats: Lacking
   - Humans: Inefficient
3. Desaturase enzymes
   - Cats: Extremely low
   - Humans: Low
4. Dietary B12 requirement
   - Cats: Essential
   - Humans: Essential

Plio-Pleistocene Hominin Diet: The Uncertain – How Much Plant Food? How Much Animal Food?

Clearly, plant:animal subsistence would have varied by season, geographic locale and food availability.

Were there general trends?

Frequency Distribution of Subsistence Dependence upon GATHERED PLANT FOODS in World Wide Hunter Gatherer societies (n = 229)

Mode = (26-35%)
Median =(25-35%)

Only 13.5% of all societies have ≥ 56% subsistence upon gathered plant foods

Frequency Distribution of Subsistence Dependence upon TOTAL (FISHED + HUNTED) ANIMAL FOODS in World Wide Hunter Gatherer Societies (n = 229)

Mode = (56-65%)
Median = (56-65%)

58% of all societies have ≥ 56% subsistence dependence upon animal foods

Shortcomings of Ethnographic Data

- The majority of ethnographic data is subjective & not quantitative.
- However, a few quantitative studies of hunter-gatherer diet do exist.

<table>
<thead>
<tr>
<th>Population</th>
<th>Location</th>
<th>Latitude</th>
<th>% animal food</th>
<th>% plant food</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aborigines</td>
<td>Australia</td>
<td>12S</td>
<td>80</td>
<td>20</td>
<td>McArthur, 1960</td>
</tr>
<tr>
<td>Ache</td>
<td>Paraguay</td>
<td>25S</td>
<td>90</td>
<td>10</td>
<td>Hill et al, 1984</td>
</tr>
<tr>
<td>Anbarra</td>
<td>Australia</td>
<td>12S</td>
<td>87</td>
<td>13</td>
<td>Meek, 1982</td>
</tr>
<tr>
<td>Efe</td>
<td>Africa</td>
<td>2N</td>
<td>44</td>
<td>56</td>
<td>Dietz et al, 1989</td>
</tr>
<tr>
<td>Eskimo</td>
<td>Greenland</td>
<td>69N</td>
<td>96</td>
<td>4</td>
<td>Sinclair, 1953; Krogh &amp; Krogh, 1914</td>
</tr>
<tr>
<td>Gwi</td>
<td>Africa</td>
<td>23S</td>
<td>24</td>
<td>76</td>
<td>Silberbauer, 1981; Tanaka, 1980</td>
</tr>
<tr>
<td>Hadza</td>
<td>Africa</td>
<td>35</td>
<td>54</td>
<td>46</td>
<td>Blurton Jones et al, 1997; Hawkes et al, 1989</td>
</tr>
<tr>
<td>Hiwi</td>
<td>Venezuela</td>
<td>6N</td>
<td>78</td>
<td>22</td>
<td>Hurtado &amp; Hill, 1986; Hurtado &amp; Hill, 1990</td>
</tr>
<tr>
<td>!Kung1</td>
<td>Africa</td>
<td>20S</td>
<td>33</td>
<td>67</td>
<td>Lee, 1968</td>
</tr>
<tr>
<td>!Kung2</td>
<td>Africa</td>
<td>20S</td>
<td>68</td>
<td>32</td>
<td>Yellen, 1977</td>
</tr>
<tr>
<td>Ntopak</td>
<td>Columbia</td>
<td>2N</td>
<td>61</td>
<td>39</td>
<td>Politis G, 1996</td>
</tr>
<tr>
<td>Onge</td>
<td>Andaman</td>
<td>12N</td>
<td>81</td>
<td>19</td>
<td>Rao et al, 1989; Bose, 1964</td>
</tr>
<tr>
<td>Islands</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEAN</td>
<td></td>
<td></td>
<td>69</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Without Eskimo, Nunamitut</td>
<td></td>
<td></td>
<td>64</td>
<td>36</td>
<td></td>
</tr>
</tbody>
</table>

Cordain L et al. Eur J Clin Nutr 2002;56 (suppl 1): s42-s52

The 13 Quantitative Studies of Hunter Gatherer Animal: Plant Subsistence

Plio-Pleistocene Hominin Diet: The Uncertain – How Much Plant Food? How Much Animal Food?

Clues From Stable Isotopes:

"The isotope evidence overwhelmingly points to the Neanderthals behaving as top-level carnivores"

Clues From Stable Isotopes:

"We were testing the hypothesis that these humans had a mainly hunting economy, and therefore a diet high in animal protein. We found this to be the case..."
Minimally Processed, Wild Plants

What are the Health Implications?

Minimally Processed, Wild Animals

Highly Processed, Refined Foods

Breads, Cereals, Rice and Pasta
Dairy Products
Added Salt
Refined Vegetable Oils
Refined Sugars (except honey)
Fatty Meats
Alcohol

Refined sugars, grains, vegetable oils and dairy = 70.9% of energy in the U.S. food supply

Grains
Refined Sugars
Vegetables
Nuts, Seeds
Legumes
Eggs
Fats
Meats, Fish
Dairy
Miscellaneous

Refined sugars, grains, vegetable oils and dairy represent Neolithic & Industrial era foods that were not present in traditional ancestral human diets.
By default, their inclusion displaces minimally processed, wild plant and animal foods.


Evolution of the Western Diet:
Neolithic (10,000 to 5,500 yrs ago) Food Introductions

WHEAT & BARLEY DOMESTICATED ~10,000 YRS AGO
FIRST DAIRYING EVIDENCE
WINE & BEER
FIRST SALT MINES
SHEEP, GOATS, COWS DOMESTICATED

Years ago
10,000 9,000 8,000 7,000 6,000 5,000 4,000 3,000 2,000 1,000

Human Generations (30 yrs)
333 300 267 233 200 167 133 100 66 33 0

These foods comprise (>70% energy) in typical Western Diets But were virtually unknown in Ancestral Human Diets


Plio-Pleistocene Hominin Diet:
The Known – Foods That Couldn't Have Been Eaten
Neolithic and Industrial Era Foods: Nutritional Implications

- As Neolithic & Industrial Era foods displace minimally processed, wild plant and animal foods, they adversely affect the following nutritional factors:
  1. The Glycemic Load
  2. The Fatty Acid Balance
  3. The Macronutrient Balance
  4. The Trace Nutrient Density
  5. The Acid/Base Balance
  6. The Sodium/potassium Balance
  7. The Fiber Content

Disruption of these 7 nutritional components fundamentally underlies much of the chronic diseases in the Western World.
Cereal grains which are the seeds of grasses (Gramineae) in their wild state are:
1. Small
2. Difficult to harvest
3. Minimally digestible without (a) grinding to break down cell walls (b) cooking to gelatinize starch granules

Cordain L. Cereal grains: humanity’s double edged sword. World Review of Nutrition and Dietetics 1999;84:19-73

Thus, the appearance of crude grindstones and mortars in the Middle East (Natifians) and elsewhere (10-15,000 years ago) heralds the beginnings of humanity’s use of cereal grains as a staple food


Wright K. The origins and development of ground stone assemblages in Late Pleistocene Southwest Asia. Paleorient 1991;17:19-45

How Cereals Were Milled until about 1880

Human Mortar & Grindstone
100% of flour (endosperm, germ, bran) used – hence 100% extraction

Water or Draft Animal
Powered Stone Mill
100% extraction, unless flour sieved of bran

Evolution of the Western Diet:
Industrial Food Introductions (Refined Cereals)

Stone Milling of Wheat
Steel Rollers to Mill Wheat
Invented ~1880

Steel rollers squeeze endosperm out of coating to leave germ & bran to be sieved off
Whereas, Stone mills pulverize & mix germ along with endosperm; bran remains unless sieved; flour particle size is mixed
Multiple breaks with steel rollers = uniformly small particle size

How Steel Roller Milling of Flour Influences Fiber Content, Particle Size & Glycemic Index

![Graph showing flour extraction rate and remaining flour](image)

High Glycemic Foods

- ALMOST ALL REFINED GRAINS HAVE HIGH GLYCEMIC INDICES
- Rice Chex Cereal 89
- Corn flakes 84
- Pretzels 83
- Rice Krispie Cereal 82
- Rice Cakes 82
- Rye bread 76
- Waffles 76
- Total Cereal 76
- Graham crackers 74
- Cheerios 74
- Bagels 72
- Short grain white rice 72
- Corn chips 72
- White bread 70
- Whole Wheat bread 69

Foster-Powell K et al. Am J Clin Nutr 2002;76:5-56

High Glycemic Load Carbohydrates Promote Diseases of Insulin Resistance

The Metabolic Syndrome or Syndrome X

- Type 2 Diabetes
- Hypertension
- Coronary Heart Disease (CHD)
- Dyslipidemia (Reduced serum HDL cholesterol, elevated triglycerides, elevated VLDL, elevated small dense LDL cholesterol)
- Obesity
- Gout


Cereal Grains Are Net Acid Producers

Potential Renal Acid Loads of Foods (100 g portion)

<table>
<thead>
<tr>
<th>Grains</th>
<th>Meats, Fish, Eggs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown rice</td>
<td>Trout 10.8</td>
</tr>
<tr>
<td>Rolled oats</td>
<td>Turkey 9.9</td>
</tr>
<tr>
<td>Whole wheat bread</td>
<td>Chicken 8.7</td>
</tr>
<tr>
<td>Spaghetti</td>
<td>Eggs 8.2</td>
</tr>
<tr>
<td>Cornflakes</td>
<td>Beef 7.8</td>
</tr>
<tr>
<td>White Rice</td>
<td>Cod 7.1</td>
</tr>
<tr>
<td>Dairy:</td>
<td>Fruits</td>
</tr>
<tr>
<td>Parmesan cheese</td>
<td>Raisins -21.0</td>
</tr>
<tr>
<td>Processed cheese</td>
<td>Black currants -6.5</td>
</tr>
<tr>
<td>Hard cheese</td>
<td>Bananas -5.5</td>
</tr>
<tr>
<td>Cottage Cheese</td>
<td>Apricots -4.8</td>
</tr>
<tr>
<td>Whole milk</td>
<td>Vegetables</td>
</tr>
<tr>
<td>Legumes:</td>
<td>Spinach -14.0</td>
</tr>
<tr>
<td>Peanuts</td>
<td>Celery -5.2</td>
</tr>
<tr>
<td>Lentils</td>
<td>Carrots -4.9</td>
</tr>
<tr>
<td>Peas</td>
<td>Lettuce -2.5</td>
</tr>
</tbody>
</table>

Cereal Grains: Acid/Base Balance

- The average western diet produces a slight chronic metabolic acidosis

Net Acid Yielding:
- 1. Cereal Grains = 23.9 % energy
- 2. Meats, fish = 15.7 % energy
- 3. Dairy = 10.6 % energy
- 4. Nuts, legumes = 3.1 % energy
- 5. Eggs = 1.4 % energy
- 6. Salt (NaCl) = 9.6 g/day

Net Alkaline Yielding:
- 1. Vegetables = 4.8 % energy
- 2. Fruits = 3.3 % energy

Neutral (but displace alkaline foods):
- 1. Refined sugars = 18.6 % energy
- 2. Refined Oils = 17.9 % energy

Refined Grains Reduce the Trace Nutrient Density of the Western Diet

Vitamin Depletion from Flour Milling

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Whole wheat</th>
<th>White flour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biotin</td>
<td>20</td>
<td>17</td>
</tr>
<tr>
<td>Vit B6</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>Vit E</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>Folate</td>
<td>33</td>
<td>18</td>
</tr>
<tr>
<td>Vit B3</td>
<td>32</td>
<td>17</td>
</tr>
<tr>
<td>Vit B2</td>
<td>30</td>
<td>16</td>
</tr>
<tr>
<td>Vit B1</td>
<td>34</td>
<td>17</td>
</tr>
<tr>
<td>Panto</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>Acid</td>
<td>25</td>
<td>17</td>
</tr>
</tbody>
</table>

Mineral Depletion from Flour Milling

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Whole wheat</th>
<th>White flour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca</td>
<td>50</td>
<td>33</td>
</tr>
<tr>
<td>Cr</td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>Cu</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Fe</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Mg</td>
<td>18</td>
<td>10</td>
</tr>
<tr>
<td>Mn</td>
<td>75</td>
<td>20</td>
</tr>
<tr>
<td>Se</td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>Zn</td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>K</td>
<td>33</td>
<td>20</td>
</tr>
</tbody>
</table>


Refined Grains Reduce the Trace Nutrient Density of the Western Diet

Diseases:
- Iron deficiency anemia, osteoporosis, Hypogonadal dwarfism
Both Whole and Refined Cereals Reduce Fiber Content

<table>
<thead>
<tr>
<th></th>
<th>Total Fiber (grams)</th>
<th>1000 kcal sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refined Cereals</td>
<td>6</td>
<td>(n = 3)</td>
</tr>
<tr>
<td>Whole Grain Cereals</td>
<td>24</td>
<td>(n = 8)</td>
</tr>
<tr>
<td>Fruits</td>
<td>41</td>
<td>(n = 20)</td>
</tr>
<tr>
<td>Non Starchy Vegetables</td>
<td>185</td>
<td>(n = 20)</td>
</tr>
</tbody>
</table>

Diseases: Constipation, appendicitis, hemorrhoids, deep vein Thrombosis, varicoses veins, diverticulitis, hiatal hernia, gastrointestinal reflux


Plio-Pleistocene Hominin Diet: The Known – Foods That Couldn’t Have Been Eaten (Dairy)

Contribution of Dairy Products To Total Energy in the U.S. Diet

<table>
<thead>
<tr>
<th>Item</th>
<th>% total energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole milk</td>
<td>1.6</td>
</tr>
<tr>
<td>Low fat milks</td>
<td>2.1</td>
</tr>
<tr>
<td>Cheese</td>
<td>3.2</td>
</tr>
<tr>
<td>Butter</td>
<td>1.1</td>
</tr>
<tr>
<td>Other</td>
<td>2.6</td>
</tr>
<tr>
<td>TOTAL:</td>
<td>10.6</td>
</tr>
</tbody>
</table>

The Displacement of Game Meats & Fish by Dairy Foods Increases Saturated Fats at the Expense of Polyunsaturated Fats & Monounsaturated Fats

Increased Saturated Fat = Increased risk for Syndrome X, CHD, certain cancers
Evolution of the Western Diet:
Neolithic Food Introductions (Dairy)

- ALMOST ALL REFINED GRAINS HAVE HIGH GLYCEMIC INDICES
- Rice Chex Cereal 89
- Corn flakes 84
- Pretzels 83
- Rice Krispie Cereal 82
- Rice Cakes 82
- Rye bread 76
- Waffles 76
- Total Cereal 76
- Graham crackers 74
- Cheerios 74
- Bagels 72
- Short grain white rice 72
- Corn chips 72
- White bread 70
- Whole Milk 27
- Yogurt 24

Despite a low glycemic load, dairy products paradoxically have insulin indices similar to white bread.

Plio-Pleistocene Hominin Diet:
The Known – Foods That Were Rarely Eaten (Fatty Meats)

- Prior to Agriculture, all animal foods consumed by humans were: Wild Animals
- The entire edible carcass (all organs) was usually consumed
- In Western countries rarely are meats other than muscle meat consumed

Fatty Meats:
Year Round Staples in Western Diets

- Salami 74 % Fat, 22 % Protein
- Bacon 77 % Fat, 21 % Protein
- Ground Beef 64 % Fat, 33 % Protein
- Hot Dogs 82 % Fat, 14 % Protein
- Pork Ribs 72 % Fat, 26 % Protein
- T-bone Steak 68 % Fat, 30 % Protein

Wild vs. Domestic Animals

- Body fat in wild animals waxes and wanes seasonally
- With the advent of animal husbandry 10,000 years ago, it became possible to attenuate or prevent the seasonal decline in body fat % by provisioning captive animals with plant food
- It also became feasible to consistently slaughter the animal at peak body fat %

Caribou
**Seasonal Change in Wild Mammal Body Fat % (by Weight)**

For 7 months out of the year, the group mean body fat % is 3.1
For the entire year, the mean body fat % is 6.8

**Seasonal Change in Wild Mammal Edible Carcass Fatty Acid Composition**

7 months out of the year:
(1) mean body fat % = 3.1 by weight
(2) mean body fat % = 24.1 by energy
(3) mean body SFA = 11.1% by energy

AHA recommendations:
(1) Total fat < 30 % energy (prevention of CHD)
(2) Saturated fat < 10 % energy

**Total ω-3 Fatty Acids in Wild, Grass and Grain Fed Animals Muscle Meat**

<table>
<thead>
<tr>
<th>Animal</th>
<th>Total n-3 fatty acids (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elk</td>
<td>178</td>
</tr>
<tr>
<td>Deer</td>
<td>225</td>
</tr>
<tr>
<td>Antelope</td>
<td>216</td>
</tr>
<tr>
<td>Pasture fed Cow</td>
<td>61</td>
</tr>
<tr>
<td>Grain fed Cow</td>
<td>46</td>
</tr>
</tbody>
</table>

Diseases linked to reduced ω-3 fatty acids: Syndrome X, CHD, cancer, autoimmune diseases, all inflammatory (“itis”) diseases
Plio-Pleistocene Hominin Diet:
The Known – Foods That Were Rarely Consumed
(Added Salt)

Total Salt (NaCl) in the U.S. Diet (Grams per Day)

<table>
<thead>
<tr>
<th>Source</th>
<th>grams/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Added in processed foods</td>
<td>7.2</td>
</tr>
<tr>
<td>Table salt and cooking use</td>
<td>1.4</td>
</tr>
<tr>
<td>Naturally occurring in foods</td>
<td>1.0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>9.6</td>
</tr>
</tbody>
</table>


Plio-Pleistocene Hominin Diet:
The Known – Foods That Were Rarely Consumed
(Added Salt)

The Mountain of Salt
(Cardona, Catalonia, Spain)

Salt was known to be gathered on a dry lake bed in China ~ 8,000 years ago
First inland salt mines appear in Europe ~ 6,000 years ago
Hunter gatherers living near the ocean dipped food in seawater and used dried sea salt


Diseases linked to salt consumption: Hypertension, stroke, osteoporosis, kidney stones, Menierre’s Syndrome, stomach cancer, insomnia, motion sickness, asthma, exercise induced asthma

Plio-Pleistocene Hominin Diet:
The Known – Foods That Were Not Consumed
(Refined Sugars)

Contribution of Refined Sugars to Total Energy in the U.S. Diet

<table>
<thead>
<tr>
<th>Item</th>
<th>% total energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sucrose</td>
<td>8.0</td>
</tr>
<tr>
<td>High fructose</td>
<td>7.8</td>
</tr>
<tr>
<td>Corn syrup</td>
<td>2.6</td>
</tr>
<tr>
<td>Glucose</td>
<td>2.6</td>
</tr>
<tr>
<td>Syrups</td>
<td>0.1</td>
</tr>
<tr>
<td>Other</td>
<td>0.1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>18.6</td>
</tr>
</tbody>
</table>


Plio-Pleistocene Hominin Diet:
The Known – Foods That Were Not Consumed
(Refined Sugars)

Crystalline sugar was first produced from sugar cane in Northern India in ~ 500 BC
Honey would have always been part of the human diet, but was only available seasonally.
Thus, year round consumption of refined sugars would not have been possible

Evolution of the Western Diet: Industrial Era Food Introductions (Refined Sugars)

Per Capita Sugar (Sucrose) Consumption in the Netherlands (1745-1937)

Per Capita Sugar (Sucrose) Consumption in England (1815-1970)

Annual Per Capita Consumption of Refined Sugars in the U.S. (1909-99)

Changes in the Refined Sugar Composition in the U.S. Diet Since 1970

- In 1960, 90% of the refined sugar in the U.S. Food supply came from sucrose
- With the advent of chromatographic enrichment technology
- Beginning in the late 1970’s it became economically feasible to manufacture high fructose corn syrup in mass quantity from corn starch


Annual Per Capita Consumption of Refined Sugars in the U.S.

HFCS has increased from 0.4 lb in 1970 to 64 lbs in 2000. Total fructose (from sucrose & HFCS) has increased from 51.5 lbs in 1970 to 64.9 lbs in 2000 (26%).

Annual Per Capita Consumption of Refined Sugars in the U.S. 1970-2000

- **1970**: Sucrose: 121 lbs, HFCS: 102 lbs, Glucose: 19 lbs
- **1980**: Sucrose: 122 lbs, HFCS: 83 lbs, Glucose: 20 lbs
- **1990**: Sucrose: 136 lbs, HFCS: 84 lbs, Glucose: 22 lbs
- **2000**: Sucrose: 151 lbs, HFCS: 66 lbs, Glucose: 22 lbs

**Plio-Pleistocene Hominin Diet:**

- **The Known – Foods That Were Not Consumed (Refined Sugars):**
  - Diseases linked to refined sugars:
    - Syndrome X (Type 2 diabetes, CHD, dyslipidemia, obesity, gout, hypertension)
    - Dental caries
    - Certain cancers

**Vegetable Oils are made via three processes:**

1. Rendering & pressing (oldest)
2. Steel expeller pressing (recent)
3. Solvent extraction (recent)

However, except for olives most oils were used for non-food purposes (lubrication, illumination, medicine)

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Contribution of Refined Vegetable Oils to Total Energy in the U.S. Diet

- **Item**
  - Salad, Cooking Oils: 8.8%
  - Shortening: 6.6%
  - Margarine: 2.4%
  - TOTAL: 17.8%

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**Plio-Pleistocene Hominin Diet:**
*The Known – Foods That Were Not Consumed (Refined Vegetable Oils)*

- High pressure steel expeller technology developed in the industrial era + new purification processes allowed non-traditional oilseeds to be exploited (i.e. cottonseed – Wesson oil -- 1899)
- The hydrogenation process was first developed in 1897 which allowed vegetable oils to become solidified to produce shortening and margarine
- Yielding novel trans fatty acids

**Portable Steel Expeller for the Extraction of Vegetable Oils**

**Per Capita Change in Refined Vegetable Oils in the U.S. (1909-99)**

- Total vegetable oil consumption has increased 459% since 1909
- Salad, Cooking Oil consumption has increased 1340% since 1909
- Margarine consumption has increased 488% since 1909
- Shortening consumption has increased 237% since 1909


**Plio-Pleistocene Hominin Diet:**
*The Known – Foods That Were Not Consumed (Refined Vegetable Oils)*

- Vegetable oils are high in ω-6 fatty acids, but low in ω-3
- Diseases linked to high ω-6/ω-3
- Syndrome X (Type 2 diabetes, CHD, dyslipidemia, obesity, gout, hypertension), cancers, autoimmune diseases, virtually all inflammatory (“itis”) diseases

**Thank You!**