Meat in Human Nutrition

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The EVOLUTION and NUTRITION

scientific (materialistic) explanation
Meat in our diet: the important evolution factor

Prior to 3.5 million years, *Australopithecus afarensis* looked for food in the African forest. 3 questions:

I. why humans began **anatomically differ from other primates** - what happened (the **first break** in the evolution)?
II. why humans have **greater brain** (the **second break** in the evolution)?
III. why a man **moved** (the **third break** in the evolution)?

**Explanation - hypothesis by (Leonard, 2002):**
- In the Pliocene, about 1.8-5 million years ago a **climate change started morphological revolution**.
- **Africa becomes drier**, forest was **disappearing** and sources of food were reduced.
- Competition of species was increasing and the Humanoid species went through important changes.
The first break in the evolution: anatomic differences - walk on two legs

- Reasons - energy sources, free arms, savanna – food, water, predators

2. *Australopithecus afarensis* (3.2 mill. years), Lucy (1974)
3. Species *Homo* (2.3 – 1.6 mill. years), Turkan’s boy (barrel-shaped chest)
The second break in the evolution: bigger brain

- Brain = 2% of human weight, but it needs 20% of calories, 60% of the infant
- Development of speech ability
- Longer and more active life (where to get more energy?)

*Ch. Darwin: natural selection* ?!

- **Meaty diet!** (like predators) ... calories, proteins = growth of the brain and also social reasons
- Our genes are from 99% like a chimpanzee!
- Only in 1.2% of our genes that are active (identifying the genes) differ from chimpanzees
- 5-6 million years ago - hominids separated from the branch of the chimpanzees
- Primate as omnivore = the most intelligent, discoveries of new resources food
Greater brain increases a need for energy

Greater brain = more energy needed; modern man needs about 10-12% more energy than Australopithecus (Sci American, 2002)

% of the energy necessary for the brain
Chimpanzee: mainly vegetable diet but also meat
Comparison of energy sources: solution by Australopithecus x Homo

„Australopithecus“ addressed the problem - morphologically.

Anatomical specializations have led to a strengthening of those parts of the body, which served for chewing a greater range of plant food. Proof may be a permanent increase in faeces of the findings later.

"Homo" solved the problem – behaviorally. 

_H. erectus_ was the first hominid, who has hunted deers in the African savanna. Proof may be a large number of the findings of animal bones in the places of the seats of _H. erectus_.

_H. habilis - tools for working of leather and cutting of meat (predators); he had a smaller abdomen and shorter bowel._
Construction of teeth, skull muscles and diet

Massive handle masseter muscles + sagittal crest

Australopithecus bosei was adapted to tough plant food

Sagittal crest is missing

Homo erectus was adapted to softer and better diet

Soft handle masseter muscles and smaller stool with a thin layer of enamel

Small incisors and canines

Large incisors

Sci American, 2002
New energy sources

It could be (1) meat, but it also could be the (2) use of fire for the preparation of vegetable food. Heat increases the digestibility of complex carbohydrates.

The added energy then let *H. erectus* start to hunt, which is energy-consuming, with greater frequency.

It seems that the origins of fire use for the preparation of food falls within the period 1.8 mil. years back, when *Homo erectus* lived.

The use of fire was a technological innovation, which would significantly affect the human diet.
The third break in the evolution of man: moving

- Early forms of *H. erectus* moved from Africa about 1.4-1.8 million years ago

- Why they moved? The reason was most likely migration of food-animals

- More hunting *H. erectus* moved with a source of food (animals)

- It is estimated that hunting *H. erectus* required **10 times** larger area to sustain than *Australopithecus*
New map of human migrations by using of DNA

- The path and the time of migrations are estimated according to the relatedness of mitochondrial DNA inherited from mother line (genes, stable)

Wikipedia EN, 2008
MEAT in NUTRITION TODAY
Old traditions in nutrition: „meat as a part of our diet = health“

- The consumption of meat continuing at least 15 thousand generations

- To consume meat - evolutionarily meant survival (man – hunter/gatherer)

- Symbol of "forces" (the mythical notions) - meat as a part of diet has been the symbol of health and prosperity

- Some societies increase production and consumption of meat for centuries
Example: meat availability in the Czech Republic during years 1948-2006
Factors driving meat consumption

- Economical (political)
- Philosophical (vegetarians, vegans, ...)
- Cultural (Guinea pig, dog, horse, donkey, Fugu fish ...)
- Geographical (climate-hot /cold areas, Inuit)
- Religious
  - Jews
    - In the Old Testament: Deuteronomy 14,8: Even the pig; While hooves, do not chewing; It will be unclean for you. You must not eat their meat nor their carcasses touch.
  - Christians
    - In the New Testament: the Corinthians 10.25: Eat all meat sold in shops, and for your conscience, you don't need to ask any questions.
  - Muslims
    - The Koran forbids pork
  - Buddhists
    - Consume meat, but strict Buddhists do not eat meat, eat beef in India is not accepted (but not strictly)
Large variation in meat consumption versus health

<table>
<thead>
<tr>
<th>Population</th>
<th>Energy (kcal/d)</th>
<th>Energy from animal food %</th>
<th>Energy from veg.food %</th>
<th>Cholesterol in blood (mg/100 ml)</th>
<th>BMI</th>
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</thead>
<tbody>
<tr>
<td>Hunters-gatherers</td>
<td>2100</td>
<td>33</td>
<td>67</td>
<td>121</td>
<td>19</td>
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<td>Kung, Botswana</td>
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<td>Inuit, America</td>
<td>2350</td>
<td>96</td>
<td>4</td>
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<td>Keepers of cattle</td>
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<td>80</td>
<td>20</td>
<td>186</td>
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<td>Turkana, Kenya</td>
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<td>Evenk, Russia</td>
<td>2820</td>
<td>41</td>
<td>59</td>
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<td>Farmers</td>
<td>2002</td>
<td>5</td>
<td>95</td>
<td>150</td>
<td>21</td>
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<td>Quechua, Peru</td>
<td></td>
<td></td>
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<td>Industrial society</td>
<td>2250</td>
<td>23</td>
<td>77</td>
<td>204</td>
<td>26</td>
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</tbody>
</table>

Why is the industrial society wrong? **Much fat and just little motion!**

Sci American, 2002
Comparison of meat „consumption“

- The world meat consumption: average \(41\ \text{kg/p/y}\)
- BUT BIG DIFFERENCES - USA: 110 kg, India 2 kg

- CZ meat consumption: average \(82\ \text{kg/person/year}\)
  - Pork: 41 kg
  - Poultry: 26 kg
  - Beef: 12 kg
  - Other: 3 kg (rabbit, mutton, horse, veal, venison)
  - Fish: 6 kg (including about 2 kg of freshwater fish)

(we are referring to consumption of „meat as produced“, not as consumed)
Comparison of meat „consumption“

- The world meat consumption
Comparison of meat „consumption“

- The world meat consumption
Comparison of meat "consumption"

- The world beef consumption
Comparison of meat „consumption“

- The world fish consumption
Comparison of meat proteins „consumption“

• The world fish consumption – a source of proteins
Today: pressure to decrease meat consumption
Health image of meat - collapsed in the 80th

• Research confirmed the **negative effect of fat** on cardiovascular disease

• Attention paid to the **fat from red meat** because it is usually the largest source of SFA in the traditional diet - confirmed in the years 1980 – 1984

• Multifactorial origin of CVD (smoking, stress, nutrition, physical activity ...) is clearly known from the 90s **negative associations about the harmfulness of red meat remains**
Decreasing of meat health reputation in the 90th

• The association between high consumption of red meat and certain types of cancer (especially colorectal cancers) - WCRF, 1997, COMA, 1998) - although there are still some disputes about causality

• BSE – panic due to possible incurable disease called new form of CJD

• Problems with foot-and-mouth disease - lack of confidence in the safety of meat, frightening scenes during destroying of herds

• Problems also with poultry (the transmission of the influenza virus) and with fish (methyl mercury contamination, parasites)
MEAT and CIVILIZATION DISEASES
Meat and cancer

- **Meat** can protect against cancer of stomach, esophagus and liver (Hirayama, 1990, Azevedo et al., 1999)

- **Meat** is suggestive of tumors causality of the colon, rectum, as well as breast or prostate (Black et al., 1997)

- 70 g culinary threatened red (!!!) meat / person / day and 500 g / person / week is considered as maximum (IARC, 2015)

E.g.
Average meat consumption in CZ (2003-4): age 18 - 59 y
men 161g/day,
women 124g/day (SISP04).
Meat and cardiovascular diseases (CVD)

- **CVD** is still the cause of more than 40% of deaths
- Regular consumption of red meat is epidemiologically associated with increased risk of CVD due to composition and fat content
- Meat is a source of arachidonic acid which is associated with increased thrombotic tendency (too simplistic assertion)
- Approximately 1/3 of cholesterol in the diet comes from red meat (CPA 97) - content is not higher in fat meat - the number of muscle fibers is higher in red muscle (DRI < 300 mg daily, recommended blood levels of 5 mmol / l)
- Lean beef, chicken or fish added to the low-fat diet in the same manner reduced the level of plasma cholesterol and LDL-cholesterol in subjects'

What to do with fat in production?
Meat and cardiovascular diseases (CVD)

Negative correlation data?
The prevalence of overweight (BMI > 25) and obesity (BMI > 30) in the population continues to grow in the CR is about 50% of obese women and 30% of men.

Feeling hungry regulates the number of meals.

Satiety regulates the size of the food consumed.

Satiating ability is highest in protein >> carbohydrates >> fat.

The mechanism satiety effect of protein is not known >> probably influence the hormonal system (AA, glucose, insulin, cholecystokinin, serotonin precursors, norepinephrine, dopamine).

After a meal with meat hunger comes later than the vegetarian diet (Barkeling et al., 1990). Varies according to type of meat (depending on the composition and digestibility AA).

The answer, whether the meat is a valuable assistant, or more harm in the fight against obesity - we unfortunately do not know.
Meat and vegetarianism

• Meat is the richest source of protein in the "Western-type diet."

• Some epidemiological studies show a reduction in the relative risk of death in people with "lower consumption of meat."

• Confounder factor "healthier lifestyle" among vegetarians supposedly (Singh, 2001) plays an important role

• Lack of evidence of specific metabolic positives of diet low in meat (Singh, 2001)

• The whole situation must be studied in context - a holistic approach>>> age, gender, lifestyle, environment, genotype and phenotype of human>>> change throughout life?
MEAT
RICH SOURCE of ENERGY
and NUTRIENTS
Meat = rich and very universal source of bioavailable nutrients

- The primary importance lies in the meat protein content in particular = contains all the essential amino acids (growth and recovery of cells of the body)

- Meat is also relatively concentrated source of essential micronutrients:
  
  - Vitamins A, D, E (adipose tissue and liver)
  - Vitamin B₁₂ (only animal food - haemopoiesis!)
  - Other B group vitamins
  - Even low doses of Vitamin C (liver and fresh blood)
  - Minerals:
    - 1% by weight of meat
    - K, Ca, Mg, Fe - high availability 35%
    - Zn - especially beef
    - I - seafood
Meat composition – mammalian muscle

- type of meat, intravital influences, technological and of cooking factors

Water: 75%
Protein: 19%
Fat: 2.50%
Sacharides: 1.20%
N-compounds and Inorganic compounds: 2.30%
Big difference among content of fat in various kinds of pork!
One portion of beef (85g) gives you:

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Content</th>
<th>%DRV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>21 g</td>
<td>46</td>
</tr>
<tr>
<td>Riboflavin (B₂)</td>
<td>0.18 mg</td>
<td>11</td>
</tr>
<tr>
<td>Niacin</td>
<td>4.4 mg</td>
<td>22</td>
</tr>
<tr>
<td>Vitamin B₁₂</td>
<td>2.0 ug</td>
<td>33</td>
</tr>
<tr>
<td>Fe</td>
<td>1.8 mg</td>
<td>10</td>
</tr>
<tr>
<td>Zn</td>
<td>4.6 mg</td>
<td>31</td>
</tr>
</tbody>
</table>
A NEW LOOK at MEAT in HUMAN NUTRITION
„Food pyramide“ – Food Based Dietary Guidelines

Podle Willet et al, 2003
New targets and trends in meat production

• The basic public health challenges early in the 21. century
  – CVD
  – hypertension
  – obesity
  – diabetes
  – osteoporosis

• The pressure to meat production:
  – reasonable to reduce the fat content
  – Fatty Acids - fat composition
  – increased content of n-3 PUFA (cardio protective, etc.)
  – *increase the content of conjugated linoleic acid (CLA)* ??? (anti-tumorogentic, normalizes blood glucose, reportedly leading the growth of muscle mass at the expense of fat) **NEW SAFETY VIEW in 2011 – CLA as t-FA???

• Increased micronutrient content:
  – such as selenium, iodine, vitamin A - dangers of excessive intakes
MEAT versus MEAT PRODUCTS

Fresh meat and meat product are not equal in terms of nutritional value.
Meat on our plate (meal)

• Meat storage?
  – Meat fresh, frozen
  – Storage time / spoilage (decomposition products)

• Meat processing?
  – What ingredients were used
  – What heat treatment was used
  – Smoking practices
Meat products for direct consume

• What kind of meat product?
  – The composition of the product in terms of fat and muscle
  – What other ingredients were used (vegetable protein, spices, additives, micro-organisms ...)

• How the meat product was further processed?
  – Categorization into groups of meat products differs in various countries (E.g. in CZ 8 groups according to the Decree No. 264/2003 Coll.)
  – Cooked meat products
  – Smoked meat products
  – Fermented meat products (probiotic??)
  – Raw meat products (tartare, carpaccio, etc.)
Conclusions

1. Recently - degradation of the meat importance in diet and a bit naive conclusions about causality of civilization diseases

2. A holistic approach used to solve problems of health, nutrition and lifestyle - rediscovery of meat importance in the evolution of human nutrition

3. Lean meat = a natural functional food – when consumed within reasonable lifestyle and health status (!) - provides certain health benefits
„ANTHROPOS“: the unique museum of prehistory in Brno