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Review

Meat nutritional composition and nutritive role in the human diet

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Meat has exerted a crucial role in human evolution and is an important component of a healthy and well balanced diet due to its nutritional richness. The present review attempts to sum up meats role and importance in human nutrition as well as examine some pejorative beliefs about meat consumption.

Meat is a valuable source of high biological value protein, iron, vitamin B12 as well as other B complex vitamins, zinc, selenium and phosphorus. Fat content and fatty acid profile, a constant matter of concern when referring to meat consumption, is highly dependent on species, feeding system as well as the cut used. Pork meat can have the highest fat content but poultry skin is not far behind. It is also crucial to distinguish meat cuts from other meat products especially regarding its association with disease risk.

As in other dietary components, moderation is advisable but meat has been shown to be an important component of a balanced diet.

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1. Introduction

Meat is a concentrated nutrient source, previously considered essential to optimal human growth and development (Higgs, 2000). Although some epidemiological data has revealed a possible association between its consumption and increased risk of several forms of cancer, cardiovascular and metabolic diseases, meat consumption has been important in human species evolution, especially the brain and intellectual development.

2. The role of meat in human evolution

Anthropology has previously recognized the importance of food and diet variations among time periods. It is possible to sum up the profile of meat consumption during human evolution in four periods: the first could be characterized by a opportunist hunting; while in the second, hunting had grown to a bigger scale and lasted 2 to 3 million years; in the third period, men started to domesticate animals and plants, which had began 10,000 years ago; during the fourth and

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last period studies determined that meat contained compounds which could increase disease risk (Larsen, 2003).

Eaton and Konner (1997) stated that human genes had not changed since the Paleolithic period. Human beings are animals, submitted to the same environmental pressure as other animals and living species (Zucoloto, 2011). With this scientists have proposed several possible influences of diet in human evolution in which some can be highlighted: cranial-dental and bowel morphologic changes and increased energy needs leading to an elevated quotient between brain and body size (Mann, 2007). Anthropological data have also suggested an important influence of meat consumption in human erect posture. Bipedalism is probably the first and most important characteristic which distinguished humans from their ancestors as it allowed a more efficient locomotion and load carrying, which are important advantages in hunting (Abitbol, 1995; Wang & Crompton, 2004). Cranial–dental changes are quite visible when analyzing hominids fossils. Molar teeth size has decreased and the jaws and front teeth have become stronger. Also shearing crests have grown. These changes could be explained through the urgent need of tearing and chewing meat rather than grinding leaves, fruits, seeds and cereals (Speth, 1989).

Gastrointestinal tract features can also aid in determining dietary preferences considering that the gut of herbivores and pure carnivores suffered different physiological and metabolic adaptations. On one hand, plant-based diets are associated with a sacculated stomach and well-developed caecum and colon, which increased with plant fiber content. On the other hand, a carnivore's stomach is well-developed and acidic with a large small intestine. Humans are omnivorous thus fitting in neither category. They have a simple stomach and a relatively long small intestine but also a reduced caecum and colon (Mann, 2007).

The fact that the small intestine is the most prominent organ in the human gastrointestinal tract is due to the need for adaptation to a varied diet, including nutritionally dense foods, with great volume and conducive to being digested in the small intestine (Milton, 1999).

Considering their body size, primates in general and humans in particular, have metabolically expensive large brains which are due to the so called encephalisation process (Aiello, 1992). However, according to Henneberg (Henneberg, Sarafis, & Mathers, 1998), the unusual human brain encephalisation is not clearly related with increases in the human brain but a relative decrease in human body size. This could be explained by taking into account the macro-evolutive enlargement suffered by the human brain in parallel with other mammals, their co-evolution with body size, the micro-evolutive decrease in human body size during considerable intellectual and cultural changes, and the virtual absence of an intra-specific correlation between brain size and human intelligence assessment methods.

Independently of what led to encephalisation, brain chemistry can be characterized by two determinants: firstly, the brain has a constant ionic and electrical information flux without which it would die. Second, this sophisticated communication network is conducted by transmembrane transfer systems which are primarily composed of lipids (60%). Brain lipids are composed of phosphoglycerides and cholesterol. They are particularly rich in long chain fatty acids, mainly arachidonic (20:4n:6) and docosahexaenoic acids (22:6n:3), both from animal tissues (Crawford, 1970).

Humans have inherited a weak capacity to produce taurine from its precursors methionine and cysteine (Chesney et al., 1998) possibly due to low levels of cysteine sulfinic acid decarboxylase (Schuller-Levis & Park, 2006) thus it must be supplied through diet. Taurine can be found mainly in shellfish like scallops, mussels and clams as well as in chicken and turkey dark meat. Despite the fact that taurine is not incorporated in proteins, this aminoacid has shown several important biological functions such as acting like an antioxidant and anti-inflammatory agent which can be related to cardiovascular disease prevention and is almost exclusively found in animal products (Wójcik et al., 2010).

Other important compounds required by humans, such as heme compounds or other porphyrin iron rich compounds are only present in meat and are preferably absorbed from meat instead of their ionic iron forms. Herbivores cannot absorb these heme complexes and depend only on ionic forms for absorption (Bothwell & Charlton, 1982).

Humans are intermediate hosts for parasites that affect carnivores, such as tapeworms from Taeniidae family from *Taenia saginata* and *Taenia solium* that can be present in raw meat (Henneberg et al., 1998).

3. Meat nutritional composition

In European legislation, the term meat refers to the edible parts removed from the carcass of domestic ungulates including bovine, porcine, ovine and caprine animals as well as domestic solipeds; poultry; lagomorphs; wild game; farmed game; small and large wild game (European Comission, 2004).

Generally speaking, meat is an important source of several nutrients. It is particularly rich in high biological value protein, as well as micronutrients like iron, selenium, zinc and vitamin B12. Offal meats like liver are also crucial sources of vitamin A and folic acid (Biesalski, 2005).

3.1. Meat protein content and protein value

The role of meat, especially red meat, as a protein source is unequivocal. However, meat protein content can vary substantially. According to the Portuguese nutritional table data (INSRJ, 2006) the average protein content is 22%, however it can be as high as 34.5% (chicken breast) or as low as 12.3% (duck meat).

It is also important to note that this protein has high digestibility scores as determined by the Protein Digestibility-Corrected Amino Acid Scores (PDCAAS). The higher PDCAAS 1.00 have been attributed to egg white and casein proteins. Meat scored 0.92, while pinto beans, lentils, peas and chickpeas which are broadly considered important protein sources in vegetarian diets scored values from 0.57 to 0.71 and wheat gluten had been classified with a 0.25 score (FAO/WHO, 1991).

Additionally, meat proteins have been distinguished by their essential amino acids content. Amino acids are proteins' building blocks. There are one hundred and ninety amino acids known although only twenty are necessary to synthesize proteins (Wu, 2009). Within this twenty, eight cannot be produced by the human body which makes them essential, thus they have to be supplied by diet. Both essential and non essential amino acids are presented in Table 1. Even if these non essential amino acids can be produced by the human body, it is mandatory to have all the raw materials necessary for their production. Inadequate consumption of amino acids, the primary units of proteins, can lead to protein malnutrition.

The nutritional value of each food can be determined by the quantity and the quality of the several amino acids present or absent. If a

Table 1
Essential amino acids and non-essential amino acids (Wu, 2009).

Essential amino acids	Non essential amino acids
	Alanine
	Asparagine
Isoleucine	
Leucine	Arginine
Lysine	Cysteine
Methionine	Aspartic acid
Tryptophan	Glutamic acid
Treonine	Proline
Valine	Hystidine
Phenilalanine	Tyrosin
	Serin
	Glycine