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Nutrition from biblical Adam to the present time

Abstract

Background: The purpose of this review is not to defend or disprove the generally accepted belief that for maintaining their health, humans need prebiotics in the form of a dietary fiber, most of all vegetable fiber. This view is so deeply rooted among both experts and the general public that it can be almost comparable to a dogma of faith. It is not surprising that it is also a subject of never-ending fight between advocates of various forms of vegetarianism and advocates for eating meat. We are trying to answer the question of who is right; or is the truth somewhere in the middle? What exactly are prebiotics? A common definition suggests that prebiotic is an indigestible part of food, which supports growth or activity of intestinal micro flora and, therefore, improves health status of the consumer. The first prebiotic in our life is lactose. Vegetable-based prebiotics appear in our food later. They provide no energy for the organism, but serve as a substrate for intestinal microbiota, support peristaltic, adsorb water, and bind cholesterol and lipids.

Keywords: nutrition, food, history

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Introduction

A short look back

Let's look back to the history of nutrition, both into the oldest parts, when the dietary regiment of current *Homo sapiens* (subtribes *Hominina*) was formed in pre-agricultural Paleolith, and also to the less old history, which started with the beginning of agriculture. So who are we actually? How are humans different from other hominins? The major differences are anatomical-morphological and physiological. It is possible to mention neotenic characteristic such as disappearance of supraorbital arcs, decrease of visceral parts and increase of cranial parts of the skull, stronger teeth enamel, changes in chewing muscles allowing to chew food from side to side, loss of fur, and development of subcutaneous fat found only in two terrestrial mammals (humans and wild pigs [*Sus scrofa*]). Another characteristic is the development of erect figure. During embryotic development, head axis turns 90 degrees, resulting in development of bipedia. In all other mammals, this axis is straightened to the body axis, resulting in quadrupedia. This fact was already known during ancient times:"*Pronaque cum spectent animalia caetera terram,Os homini sublime dedit coelumque videre Jussit, et erectos ad sidera tollere vultus.*

While the creatures of others are gathered, they look into the earth, He gave the man a face that he could look into the heavens, gave him an upright head, and preached to the stars to lift (*Publius Ovidis Naso*).[1] Here we need to remember that bipedia is energetically more demanding and, therefore, needs a higher supply of calories, which can be provided only by meat.

Fossil discoveries clearly show that our ancestors were vegetarians. It was concluded that diets of ancestral man derived from diets of higher primates and were mainly plant based,[2] but the changing environment slowly forced them to move from mainly vegetarian food to nutrition based on meat. Reliance on animal flesh increased substantially after 2 million years with the evolution of *Homo habilis* and especially *Homo erectus*, who were already capable of hunting larger game. It was also shown that contemporary hunter-gatherer populations consumed more gathered plant food than hunted game meat.[3] During a period greater than 2 million years, the world underwent several periodical changes: the ice age and the interglacial age. Climate changes, influencing mostly plants, and long cold periods, limiting availability of consumable plants, both inevitably resulted in changes of nutritional orientation towards meat. It is assumed that this shift was rather gradual.

New species of hominins gradually added more and more meat to their food. The meat included mostly fish, small animals, and insects but, in some cases, large animals such as horses and pigs.[4] This is supported by findings of Mesolithic piles of shelves (so called kjøkkenmøddings) at the Danish, Swedish, Portuguese, Indonesian, and Vietnamese coasts.[5] The strategy of finding food and frequency of consumption also changed, further distinguishing our ancestors from primates. Typical primates, including the closest relative of hominins, eat in small doses throughout the day. This trend was completely reversed by the appearance of meat and by the fact that the meat was obtained by hunting, which did not allow constant eating. Humans are the only primates who collect food to be consumed later. This frequency of food income exists even today; regardless, that in modern society, we should be able to eat as current primates (i.e., constantly). Even our closest biological relatives, the chimpanzees (*subtribus Panina),* do not have delimited feeding times. With the switch from vegetable to meat, the need to prepare food arrived. The differences in food habits of humans and other primates are summarized in Table 1.

The addition of meat to the diet and subsequent changes in nutritional habits formed the basis of subsequent evolutionary adaptation of hominins towards *Homo sapiens.* Australopithecus was either vegetarian or omnivore, but for sure not a carnivore. The move from being herbivore, which is common for current higher primates (gorillas and orangutans) to being omnivore and/or carnivore might occur at *Homo erectus,* who lived in dryer regions characterized with regular changes of seasons. Comparative studies of teeth from fossils of early hominins and great apes confirm this hypothesis. In hominins, we can observe reduction of canines, premolars, and molars. Changes in craniomandibular morphology allowed later development of articular speech. All of these changes allowed for increased brain size, improvements of brain capacity and functions, and development of the second signal system, all of which are unique for genus *Homo*. Vegetables were never the most important food source for advanced evolutionary stages of hominins, despite this, they still represented a significant part of their energetic income.[6]

Most studies suggest that ancestors of hominins and early hominins gained approximately 35% of energy from fatty food, 35% from saccharides, and the rest from proteins. Intake of dietary fiber

was around 100 g/day, which is a number current nutritionist can only dream about. A significant amount of energy came in the form of essential amino acids from meat, which also offered easily utilized dietary nucleotides, useful in growth and regeneration of tissues.[7] Later, hunters-gatherers increased the meat intake, and their food ratio changed to 22% of energy from fatty food, 37% from saccharides, and 37% from proteins.[8] Thirty-five percent of energy came from plants and vegetables, which is considerably different from our current diet consisting of cereals (31%), milk (14%), drinks (8%), vegetable fats and oils (4%), and sweets (4%).[9] All these differences are not based on needs, but on availability of food.

Table 1 Behavioral differences in food habits of humans and other primates

- Leaving a continuous food intake
- Carry off food at one location (campground)
- Gathering / storing (preserving) food for later
- Distribution of food provision, hunting - men, collection – women
- Reparation of food (fire), flavoring (salt)
- Including meat as principal components of food

It is clear, historically, that potentially harmful trans fatty acids were not a significant part of the diet. Our current intake of unsaturated fats ratio (*n*-6:*n*-3), which is approximately 10:1, it used to be 2:1. In addition, we can expect high cholesterol intake due to the use of bone marrow, brain, and other entrails of hunted animals. On the other hand, as long as the meat of hunted animals is not bled to death (unlike current meat from slaughterhouses), it contains an adequate amount of vitamin C, especially within the blood (8–12mg/l), and good amount of iron (75mg/l), clearly neutralizing possible nutritional problems of a meat-based diet.[10,11]

Fiber represented approximately 100 g/day, but phytate (phytic acid in salt form) contents, which inhibit absorption of minerals like iron and zinc or calcium,[12] was negligible. Uptake of vitamins and minerals is estimated to be 1.5–8 times higher than today, with the only exception being sodium with less than 1,000 mg/day. With respect of fruit, vegetables, cereals and milk products, as they are considered today, intake was also extremely low.[13]

In first months of life, lactose (forming approximately 7% of human milk) acts as a prebiotics. Lactose is basically not metabolized in the small intestine, but is mostly fermented in the large intestine, where it supports the growth of bifidobacteria and lactobacteria. In addition, lactose is the startup material for production of additional prebiotic galactooligosaccharides. Plant-derived prebiotics appear in our nutrition only in more advanced life phases.

Nutritional behavior (i.e., the type of food and its processing) significantly influenced the further evolution of hominins, resulting in current *H. sapiens*. Meat became the main staple of our food more than 1 million years ago.[14,15] Similarly, it was a significant factor in human sociogenesis, allowing radial adaptation first in Africa and later their subsequent expansion to Europe and Asia. The major migrations of our ancestors started before Neolithic (i.e., before agrarian revolution and use of domestic animals) approximately 60,000–45,000 years ago. Around that time, people started to leave their African cradle and filled almost all habitable regions, despite the climatic and geographical differences.[16]

Look back to recent history

At the start, we feel it is necessary to bring to mind conservative and inertia of genome. Genes regulating metabolism in genus *Homo* were determined during millions of years. It look more than 100,000 generation before the originally vegetarian genome of food collectors and occasional hunters adapted to nutrition based on meat. However, approximately 10,000 years ago (which means only 500 generations), agrarian revolution significantly narrowed the variety of food, despite the addition of milk and cereals, and at the same time returned fruits and vegetables to our menu. The last significant change appeared during the industrial revolution and it took only 10 generations to switch to technologically processed food. These changes were also accompanied with a rather uniform westernized lifestyle. With reduced variety came the intake of highly calorized food, resulting in the increased appearance of obesity and leading to current high rates of noncommunicable diseases such as cardiovascular problems, diabetes 2, and cancer.

All this means nothing other than the fact that the overwhelming majority of our genes has prehistoric origin, indicating that the genetic composition of the modern man genome is still extremely similar if not identical to the genome of our Paleolithic ancestors.[17] Cordain et al state that the biggest problem lies in the fact that "our genes do not know that and program us today in the same way they did 40,000 years ago." It all boils down to the statement: we are what our ancestors ate.[18]

The food of hunters and gatherers is assumed to be one of the most balanced diets. Ethnographic research in the South African !Kung tribes showed that plant foods formed 67–70% of their average daily nutritional dose and the rest was meat of small animals and insects of various species.[19,20] A similar conclusion can be reached from ethnographical studies of Aboriginal Australians, who are considered to be the oldest nation to have not changed its nutritional habits for more than 60,000 years. The seemingly monotone diet of nations living in extreme regions around northern polar circle is in fact similar to the diets mentioned above. Copper Inuits (or Kitlinermiut) until recently obtained 55% of food from hunting and the rest from fishing. Canadian Indians Mistassani Cree living in similar conditions have a 25–75% ration of food origin. These nations probably obtain at least some plant-derived fiber from eating the stomach content of hunted herbivores.[21]

On the other hand, the complete opposite can be said about first agricultural nations. From a nutritional point of view, they returned to the nutrition of herbivore ape-men. Their nutrition is based entirely on grains supplemented with some fruit and vegetables, and due to minimal consumption of meat lacks some essential nutritional components. Grains covered the nutritional necessities, but did not provide adequate amounts of sodium; calcium; vitamins C, B_1, and B_{12}; or lysine. The results of these deficiencies was the lower height and higher sensitivity to various illnesses, which was particularly pronounced in the high mortality of children. A typical disease connected with these agricultural tribes is beriberi, caused by a vitamin B_1 deficiency, or Keshan disease (juvenile cardiomyopathy; named after Keshan county in western Heilongjiang, China), caused by selenium deficiency. It is also important to note that nutrition with an overwhelming plant-derived majority also contains more saccharides, often leading to chronic hypoglycemia, which might result in significant changes in behavior and in increased aggressiveness.[14] The main positive and negative factors of Neolithic revolution are summarized in Table 2.

Nutritional habits of agrarian nations became more balance during Neolith, mostly due to addition of fruit, vegetable, legumes, and

meat from hunted and, to lesser extent, from domesticated animals. A nutritional complex consisting of 50% of necessary proteins originating in grain, 40% in meat, and 10% in milk and collected fruits and vegetables occurred much later.

Nutritionally divided world

At the beginning of Paleolith, collecting of food was the primary way. Middle Paleolith (250,000–40,000 years) is still experiencing gatherer-hunter type of subsistence, with significantly improved ways of hunting, which became a team affair. Approximately 12,000 years ago is the end of the last ice age. Increased temperature offered better conditions for agriculture, leading to a more settled lifestyle and better adaptation to the biotope. The real agriculture (in the common sense) arrived, followed by domestication of animals, from cattle to dogs. All of this resulted in the abrupt increase in population. Similarly, the input of energy was strongly higher than in Paleolith.[22]

Table 2 Main positive and negative factors of agrarian Neolithic revolution

Positive factors
- 50× higher food production at the same area in plant breeding and cattle breeding
- Population growth, settling in permanent housing estates

Negative factors
- Increasing population density
- Wars for obtaining the necessary resources
- The onset of epidemics of:
  - Infectious diseases
    - Measles, tuberculosis, smallpox - transmission through an interspecific barrier between cattle and humans
    - Influenza, black cough, malaria - from pigs, ducks, chickens
  - Noncommunicable diseases
    - Celiac disease, diabetes 2, xerophthalmia (deficiency of vitamin A), beriberi (deficiency of vitamin B_1)

Before Neolith (i.e., before the beginning of agricultural revolution), the population density was rather low. It is assumed that collecting and hunting can sustain 1 person/10km^2, in optimal cases per 1km^2. This sparse settlement did not allow dangerous spread of infectious diseases; thus, this period is fittingly called the pre-epidemic phase of development of mankind.

Everything, however, changed with occurrence of farming, which could occur only in specific conditions such as fertile soil and solid watering in relatively limited regions without extreme climate changes. The predominant part of the land suitable for habitation where the forests, steppes, and the tundra. These conditions did not allow soil cultivation nor, therefore, the growing of sufficient amounts of plants. Subsequently, these regions were populated by people whose main nutritional intake came from meat and fat of hunted animals and fish. In vast regions of savannas lived nomadic shepherds, who improved their diet with milk, but due to the constant movement, could not cultivate the land.

The introduction of agriculture divided the nutritional world into two parts. Primitive horticulture and primitive cultivation allowed sustainment of 1–3 persons/1 km^2, advanced agriculture improved these numbers to 10–20 persons/1 km^2 and, in combination with animal husbandry, up to 165.[23] The increasing population density and the occurrence of bigger settlements with higher numbers of inhabitants caused the unprecedented increase of new infectious diseases. The epidemic phase of humanity arrived.

If we follow the development of mankind in Europe between~500 BCE to 1,000 CE, and more specifically in Egypt and in Middle East, we will see two diametrically different nutritional cultures being developed simultaneously. On the one hand, it was well-developed ancient culture of Greeks, Romans and Egyptians, based on agriculture and fruit growing. In these cultures, the most important crops were grains, olives, and wine. Sheep horticulture and fishing were secondary, and milk and milk-related products were marginal. It is clear that this Mediterranean alimentary system was mostly vegetarian.

The Romans named cultivated regions close to towns as "*ager"* and the uncultivated area as "*saltus*". In the wild natural areas of colder Eurasian regions lived "barbarian nations", still using meat-based nutrition of Paleolithic hunters. In Europe, these nations were represented mostly by Celts, Germans, and later Slavs. More distant Eurasian steppe regions were inhabited by nomadic pastoral nations such as Skytes and Turco-Mongolian and Mongolian tribes. Their nutrition was based on meat, animal fat, milk-related products, and partly of wood-derived plants (Eskymos, Laplanders). Greek and Roman authors considered this type of nutrition as uncivilized and far from ideal, and best described by Roman physician Aulus Cornelius Celsus – "the best food is bread, because it is more nutritional than anything else." Almost a century earlier, Gaius Julius Caesar mentioned that "Germans do not work on fields and their food consists mostly of milk, cheese and meat."

It is worth mentioning that nations having nutrition based on meat and milk for many generations were still able to establish and govern one of the biggest empires in the history of mankind; which, in the Eurasian region, was the Mongolian empire. This empire was inhabited by nomadic pastoral tribes which, during the periods of maximal expansion, ruled territory of about 33 million square kilometers (i.e., 22% of all dry land) with over 100 million people. Their food is best described in the book History of Mongols (*Historia Mongalorum quos nos Tartaros appellamus*),[24] written by the Franciscan monk and traveler, Friar Giovanni DiPlano Carpini, who was sent by the pope to the Mongolian Chan Gujuk: "They have no bread or vegetables or anything similar, but meat."

It is important to remember three historical facts:

a) Way of life of nomadic people represents the overwhelming period of human history, significantly greater than agriculture;

b) Nomadic way of life does not allow any substantial agriculture; and

c) Nomadic tribes managed to overcome gigantic areas of Old World, to hold them for centuries, and to establish the biggest empires in history.

Conclusion

The main purpose of this contribution was not to defend and promote meat-based nutrition. Similarly, we did not try to denounce vegetarianism. Our aim was to draw attention to the fact the evolution directed humans towards nutritional opportunism (i.e., towards using any available food source and not towards narrow nutritional specialization). It is best to cite the famous paleontologist, E. R. Leakey:[25] "Real secret of success of human evolution is in fact that all changes always directed towards simplicity and towards preservation of ability to evolve further and not towards excessive specialization, which leads to a dead end."

Our ancestors, originally obtaining food by means of hunting and collecting, had to move widely to obtain enough food. Resulting food composition was clearly seasonal and changed periodically. In the last 5,000–10,000 years, mankind changed their ways of getting food to agriculture and pastoral farming. Nutrition was based partly in the results of farming and partly on food from commercial animal production.

Nutritional behavior (or food choice), means of seeking food, and preparation of food are directly caused by the relationship between humans and natural conditions around them, and represent a part of culture characterizing individual human communities.[26] Contrary to close relative primates, the plasticity of the human genome was and still is much wider and, therefore, allowed us to use a wide palette of food sources. Another human-specific difference is their cultural adaptive strategy; meaning, the complex of tools and techniques used in seeking and preparation of food.[27]

It is necessary to know the following important facts: Current populations, regardless of their race or cultural sphere, are genetically adapted to the nutritional environment of their ancestors before the Neolithic revolution (before start of agriculture). It was mostly nutritional nonspecialization which formed all that distinguish us from our ancestors and from closely related primates. This involves our morpho functional endowment and anatomical-ergonomic differences including development of intelligence, cultural display, and, at the end, our current technological civilization. It was our genetic makeup which for millennia determined our nutritional adaptability (i.e., ability to opportunistically use every food source available). The differences in nutritional behavior between human and other primates and higher mammals are summarized in Table 3.

Our current westernized diet contains some food types which were never used by Hominini and early *H. sapiens*. These include milk products such as cheese and butter (approximately 10.6 % of energetic contribution), cereals (23.9%), saccharides (18.6%), vegetable fats (17.6%), and alcohol (1.4%).[28] The future of mankind will depend on providing, use or abuse of food, and on decisions and development of technologies for their processing. It is imperative to consume energetically balanced food and not to promote only some nutritional components or fashionable nutritional behavior.

Table 3 The seven universal characteristics of the *H. sapiens* nutritional behavior, which formed during 3 million years of evolution of hominids, and which also shape our current nutritional behavior

1.	**We are extremely omnivorous**
We eat hundreds of different species of animals, plants, fungi and algae	
2.	**We have different systems of food transport**
From the point of her collection/hunt to the place of her consumption	
3.	**We have different food storage systems**
Including long-term protection and preservation of food nutritional value up to the time of consumption	
4.	**We use different food processing and food preparation technologies**
Cooking, steaming, frying, baking, detoxification, mixing, flavoring, coloring; from the use of fire (*H. erectus*) to the microwave oven (*H. sapiens*)	
5.	**We regularly deliver and exchange food**
We have various cultural rituals, we eat together	
6.	**We have different taboos or ritual prohibitions on different foods (meals)**
Certain types of food and food by age, sex, pregnancy and culturally-religious regulations	
7.	**We use food for non-eating purposes**
As a medicine, as a symbol of a ritual sacrifice	

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Conflict of interests

Authors declare that there is no conflict of interest.

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