Review

The history of nutritional sciences

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Human history began with the understanding of food, including what can be eaten, what cannot be eaten, and what is beneficial for health. This is the earliest and simplest form of food nutrition for humans. The history of nutrition, from ancient dietary habits to modern nutritional science as we know it today, is a fascinating journey spanning thousands of years. This article provides a comprehensive overview of the development history of human nutrition.

Key Words: nutrient discoveries, evidence based nutrition, new nutrition science, personalized nutrition, sustainable healthy diet

ANCIENT AND PREHITSTORIC NUTRITION (BEFORE 3000 BC)

Hunter gatherer diet: Early humans consumed wild plants, fruits, nuts, and hunting animals, leading to a high protein, high fiber diet.

The discovery of fire (1.5 million years ago): The discovery of fire made early human cooking possible. Through cooking methods such as barbecuing, the pathogenic microorganisms of leftover animal flesh—particularly in the absence of refrigeration—could be significantly reduced, thereby lowering the risk of foodborne illness. Additionally, cooking food can improve digestion and nutrient absorption.

The Agricultural Revolution (10000 BC): As hunting declined, making a living through it became increasingly difficult. Humans began shifting towards agriculture by introducing grains (wheat, rice, corn), dairy products, and legumes, significantly altering the composition of their diet. The Dadiwan site in China has discovered 8,000 year old carbonized plants of the millet of family poaceae and rapeseed of cruciferous, proving that human agricultural culture had already begun at that time.¹

As early as 6000 years ago, Egyptian priests documented the use of food as medicine, representing one of the earliest known references to the dual role of food as both nourishment and medicine in human history.²

EARLY CIVILIZATION (3000-500 BC) AND NUTRITION

Specific dietary ingredients, foods, beverages, and plants with pharmacological effects were employed to prevent and treat diseases. From 600 BC to 300 AD, a system of inductive and deductive thinking on food and health was formed, laying the foundation for modern nutrition.

Egypt (3000 BC): Recorded use of fermented foods (bread, beer) and herbs.³

India (1500 BC): Ayurveda describes food as medicine and emphasizes balance (such as Charaka Samhita, one of the fundamental texts of Ayurveda), which should be the earliest work in the world proposing the concept of food medicine homology.⁴

Greece (400 BC): Hippocrates (460-370 BC), known as the "father of medicine", proposed to "make food your medicine" and linked diet with health.⁵

The Yellow Emperor's Inner Canon (circa 200 BC) emphasized dietary balance through the concept of yin and yang in food. It proposed that the five grains form the foundation of nourishment, the five fruits provide auxiliary support, the five types of animal meat offer supplementary benefits, and the five vegetables serve as essential fillers. When the flavors and energetic properties of these foods are harmonized, they are believed to replenish *Jing* (essence) and enhance Qi (vital energy).⁶

NUTRITION IN THE MIDDLE AGES (500-1500 AD)

From the 8th to the 12th century AD, Arab culture, encompassing Persian influence, fostered the work of prominent scholars such as Avicenna (Ibn Sina), Ibn al-Battani, Maimonides, and the Jewish physician associated with Saladin. Their collective contributions led to the establishment of the first medical school in Europe, located in Salerno. One of the most influential outcomes of this period was Avicenna's *Canon of Medicine* (circa 1100 AD), a comprehensive medical text that included significant insights on food and nutrition. It is regarded as one of the earliest printed works to systematically address the role of diet in health.⁷ During the Islamic Golden Age (8-13 centuries) period, scholars like Avicenna (Arabic

Corresponding Author: Prof Duo Li, Institute of Nutrition & Health, Qingdao University, 308 Ningxia Road, Qingdao, China Tel: +86-532-82991018 Email: duoli@qdu.edu.cn Manuscript received 02 May 2025. Initial review completed 05 May 2025. Revision accepted 14 May 2025. doi: 10.6133/apjcn.202506_34(3).0001 Ibn Sina, 980-1037), born in present-day Uzbekistan and often regarded as the father of early medicine, made significant contributions to the understanding of food digestion and the properties of various foods. Avicenna, along with his contemporaries, advanced early dietary theory by integrating medical, philosophical, and nutritional perspectives. In contrast, during the same period in Europe, monastic communities promoted dietary moderation, while malnutrition—such as scurvy—was prevalent among the general farming population due to limited dietary diversity and poor access to fresh produce.⁷

THE AGE OF NUTRITIONAL EXPLORATION (15th-18th CENTURY)

As an original and ancient philosophy of life centered on diet and nutrition, this theory persisted throughout the entire Renaissance period in Europe and the Enlightenment period in the 18th century.⁸ In fact, many countries continue to preserve these ancient philosophical traditions, which have evolved into conceptual systems of food and nutrition rooted in harmony with the natural environment. The Greek term *diaita* originally meant "way of life" or "way of existence," reflecting the holistic view of diet as a lifestyle rather than mere food intake.⁹ In Europe, it was not until modern times that the term "diet" came to be used as a conceptual framework for food in treatises and manuals.^{10,11}

Early Nutritional Theory: Santorio Santorio (1561-1636): A Slovenian-Italian doctor, physicist, and physiologist, he was a pioneer in the study of metabolism and medical device innovation, utilizing weight measurement as a tool to examine metabolic processes.¹²

Discovery of scurvy: James Lind (1716-1794), a Scottish naval surgeon, is considered a pioneer in clinical nutrition and the treatment of scurvy. In 1747, he conducted an experiment in which twelve sailors afflicted with scurvy were divided into six pairs, each receiving a different dietary intervention: citrus fruits (lemons and oranges), cider, vinegar, seawater, a mixture of garlic, mustard, and horseradish, and barley water. The results demonstrated that citrus fruits could both prevent and cure scurvy. This discovery led to the later understanding that scurvy is caused by a deficiency in vitamin C. Lind's study is regarded as one of the earliest examples of a randomized controlled trial (RCT) in the field of nutrition.¹³

19th CENTURY - THE BIRTH OF NUTRITION SCIENCE

The origins of modern nutrition can be traced to the early to mid-19th century, when nutritionists developed a comprehensive and far-reaching understanding of their work and its societal implications. Their writings and teachings laid the foundation for dietetics, establishing it as an empirical discipline. This advancement contributed to the recognition of dietetics as an independent auxiliary medical profession. The first generation of physiologists, biochemists, chemists, and physicians who helped shape the field of nutrition science believed their work had the potential to transform society. This view was widely embraced by both governments and industry. Although still a nascent field, nutrition research spanned a broad range of topics and had practical applications beyond mere philosophy, serving as a vital tool for national health and well-being. $^{\rm 14}$

Macronutrients: Swedish chemist Jöns Jacob Berzelius (1779–1848) and Dutch chemist and physician Gerardus Johannes Mulder (1802-1880) studied substances such as albumin and fibrin, discovering that they shared similar chemical compositions. In 1838, they identified these substances as a distinct class of biomolecules, which they recognized as essential for life and later named proteins.^{15,16} François Magendie (1783-1855), an early French physiologist, was appointed Professor of Medicine at the Collège de France in Paris in 1831. He conducted pioneering research on the nutritional value of various food extracts and concluded that a moderate amount of protein is essential in the diet. His work laid the foundation for the field of nutritional science.¹⁷ Justus von Liebig (1803-1873), often regarded as the father of German organic chemistry, introduced the classification of macronutrients-carbohydrates, fats, and proteins-in the 1840s and conducted foundational research on their metabolism.¹⁸ Louis Pasteur (1822–1895), a French microbiologist and chemist, revolutionized the understanding of food safety in the 1860s with his introduction of the germ theory. His development of the pasteurization process significantly extended the shelf life of food, marking a major advancement in food preservation.¹⁸

THE GOLDEN AGE OF NUTRITION IN THE 20th CENTURY

In this century, evidence-based nutrition has advanced rapidly, with numerous nutrients being identified and their roles confirmed. Nutrient reference intake levels and dietary guidelines have been established, providing a solid framework for public health nutrition.

Between the 1920s and 1930s, vitamins A, B complex, C, D, and E were successively isolated and identified. Christiaan Eijkman (1858-1930), a Dutch pathologist and physician who was appointed Professor of Bacteriology at Utrecht University in the Netherlands, discovered that beriberi was not an infectious disease but was linked to the consumption of polished rice, which was later recognized as a deficiency of vitamin B-1. For these groundbreaking observations, Eijkman was awarded the Nobel Prize in Physiology or Medicine in 1929.19 In 1912, Casimir Funk (1884-1967), a Polish-American biochemist often referred to as the father of vitamins, coined the term "vitamine" (amine of life) to describe these essential nutrients.²⁰ In 1913, Elmer Verner McCollum (1879-1967), a pioneering American biochemist and nutritionist, along with his assistant Marguerite Davis, identified a fatsoluble nutrient in butterfat and egg yolks, which they initially termed "Factor A" (later named vitamin A). This discovery explained why animals fed diets deficient in this nutrient developed night blindness and xerophthalmia (dry eye disease). McCollum's experiments demonstrated that cod liver oil, which is rich in vitamin A, could reverse these conditions, thereby linking nutrition directly to disease prevention. In 1921, McCollum further demonstrated that when vitamin A was destroyed in cod liver oil, the anti-rickets effect persisted, leading to the discovery of vitamin D.²¹ Herbert McLean Evans (1882–1971) and Katharine Scott Bishop (1889-1976), two American researchers at the University of California, Berkeley, discovered in 1922 that rats on a diet lacking a specific fatsoluble factor developed reproductive problems. These issues were reversed when a substance from lettuce or wheat germ oil was added to their diet. This substance was later identified as vitamin E. Vitamin E was chemically isolated by Gladys Anderson Emerson (1903-1984), and its active form, alpha-tocopherol, was identified 1936.²²

Research on essential nutrients (1930s): George Oswald Burr (1896–1990), an American pioneer in the study of essential fatty acids, and his wife Mildred Burr (1902– 1989), an often-overlooked pioneer in the field, discovered the essential nature of omega-3 and omega-6 polyunsaturated fatty acids.²³

Metabolism of carbohydrate - Krebs cycle: Hans Adolf Krebs (1900–1981), a German-born British doctor and biochemist, was a pioneering scientist in the study of cellular respiration, a biochemical pathway crucial for energy production within cells. He is best known for discovering two essential chemical reactions in the body: the urea cycle and the citric acid cycle, both of which he elucidated in 1937. The citric acid cycle, commonly referred to as the "Krebs cycle" or the tricarboxylic acid cycle, is a key sequence of metabolic reactions that generates energy within cells. This groundbreaking discovery earned Hans Adolf Krebs the Nobel Prize in Physiology or Medicine in 1953.²⁴

Nutrition and Health Cohort Study: In the 20th century, as researchers began systematically tracking dietary habits and health outcomes. The Framingham Heart Study, established in 1948, is a landmark American cohort study primarily focused on cardiovascular health. However, it also incorporated dietary assessments, making it one of the earliest long-term studies to investigate the role of nutrition in chronic diseases.²⁵ The study established methods for tracking diet and health outcomes, which have since influenced subsequent nutrition-focused cohort studies.

In the 1950s, Ansel Keys (1904–2004), an American nutritionist, conducted the Seven Countries Study, investigating the relationship between dietary fat, cholesterol, and cardiovascular disease across different populations. This study is widely regarded as one of the most influential in integrating nutrition into cohort methodology.²⁶ Ansel Keys is renowned for developing the famous Keys Equation, which is used to estimate basal metabolic rate (BMR).²⁷

Dietary reference intake and dietary guideline: The first Recommended Dietary Allowances (RDA) were published by the Food and Nutrition Board of the National Academy of Sciences in 1941.²⁸ The first official dietary guidelines were released in 1980 by the U.S. Department of Agriculture (USDA) and the U.S. Department of Health and Human Services (HHS) as part of the Dietary Guidelines for Americans (DGA) initiative, which advocated for a low-fat diet.²⁹ After World War II, the processed food and fast food industries rapidly expanded, leading to the widespread availability of convenience foods and fast food.

THE 21st CENTURY: MODERN NUTRITION SCIENCE

Entering the 21st century, international nutritional science initiatives began to re-evaluate the field and scope of nutrition research, recognizing that traditional concepts could no longer keep pace with the rapid developments in human health and society. As a result, in April 2005, the International Union of Nutritional Sciences (IUNS) and the World Health Policy Forum jointly organized a symposium on "New Nutrition Science" in Gießen, Germany, where they issued the "Giessen Declaration".³⁰ The 'Giessen Declaration' provides a detailed explanation of the definition and research objectives of new nutrition science: Nutrition is a discipline that studies food systems, foods and beverages, their nutritional components and other constituents, and their interactions within the body and with all related biological, social, and environmental systems. Thus, the concept of new nutrition science was formally established. New nutrition science focuses on the health of individuals, populations and the planet. Scientists aim to systematically explain this threedimensional approach, asserting that new nutritional research must embrace unique and unprecedented opportunities and challenges specific to the 21st century.³¹ The opportunities and challenges now facing the field of nutrition differ significantly from those encountered after the establishment of traditional nutrition in the mid-19th century. New nutrition science is poised to address many of the critical issues humanity faces in the new millennium, including continuous population growth, long-term malnutrition, rising obesity and diabetes rates among youth, widening disparities between nations and ethnic groups, increasing global food demand, and the depletion of natural resources. Traditional nutritional research is illequipped to tackle these complex issues. As such, some experts argue that only by integrating traditional nutrition with biology, social sciences, and environmental sciences can nutrition effectively fulfill its role in protecting, maintaining, and advancing life on Earth. This new paradigm will guide the evolution of nutrition toward a more holistic, macroscopic approach, contributing to the resolution of global health challenges.³¹

Development of sustainable food: Since the beginning of this century, food sources such as insect protein, labgrown meat, and microalgae cultivation have garnered significant attention and development as alternative food supplements. Additionally, functional foods and dietary supplements, including vitamins, minerals, fish oil, krill oil, prebiotics, probiotics, and natural bioactive compounds such as ubiquinones, carotenoids, polyphenols, polysaccharides, and peptides, continue to grow in popularity. However, humans also face significant nutritional challenges: the rising prevalence of obesity and other non-communicable diseases, often linked to the consumption of ultra-processed foods high in salt, sugar, and fat, as well as sedentary lifestyles. In addition, micronutrient deficiencies, including those of iron, iodine, and vitamin D, remain prevalent in many developing countries.

Sustainable healthy diets: In 2019, the FAO and WHO introduced the concept of sustainable healthy diets, which involves designing one's own diet by referencing dietary guidelines and combining traditional eating habits with current circumstances to create a suitable healthy diet for oneself.³²

Personalized nutrition, also referred to as precision nutrition, represents the ultimate goal of nutritional science and has advanced rapidly in recent years. It involves the use of multi-omics approaches, such as nutrigenomics and nutrigenetics, along with clinical examinations to evaluate and diagnose nutritional needs. This enables the development of tailored dietary or nutritional supplement plans for individuals. Nutrigenomics, specifically, is the science that studies the effects of nutrients and bioactive food components on human gene transcription, translation, expression, and metabolism;³³ nutrigenetics is the science that studies the impact of genetic variations on dietary responses. In addition, several advanced technologies and methods are being applied to nutrition science research, including microbiome analysis, data science, artificial intelligence (AI), and machine learning. These innovations enhance the exploration of the scientific factors underlying diet and nutrition.³⁴

The history of nutrition is intrinsically tied to the history of humanity. As humans first appeared on Earth, they

Year	Key Discovery/ Event	Discoverer(s)	Details
1747	Citrus prevents scurvy (vitamin C deficiency).	James Lind	Conducted experiments showing that oranges and lemons cured sailors with scurvy, though
1838	Protein is essential for life	Jöns Jacob Berzelius and Gerardus Johannes Mulder	vitamin C was not identified until later. Studied substances such as albumin and fibrin, and found that they had similar chemical compo- sitions, identified them as a unique class of bio- molecules essential for life known as proteins
1897	Vitamin B1 prevents beriberi.	Christiaan Eijkman and others	Eijkman's experiment found that polished rice lacked vital nutrient presented in rice husk (later identified as vitamin B-1) developed symptoms similar to beriberi.
1912	Discovered vitamins (term "vita- min" coined by him).	Casimir Funk	Discovered that vitamin deficiencies caused diseases like beriberi and scurvy.
1913	Vitamin A is identified.	Elmer McCollum	Identified vitamin A in eggs and butter; essential for vision and immune function.
1921	Vitamin D is discovered through its role in calcium absorption.	Elmer McCollum	Destroyed vitamin A in cod liver oil (by oxida- tion) and found it still cured rickets in dog, he named this newly identified substance 'vitamin D'.
1930	Essential fatty acids are discovered.	George Oswald Burr and Mildred Burr	Identified omega-3 and omega-6 fatty acids as essential for human health, leading to under- standing of lipid metabolism.
1936	Vitamin E is identified, crucial for reproductive health.	Herbert McLean Evans, Katharine Scott Bishop and Gladys Anderson Emerson	Discovered diet lacking a certain fat-soluble factor developed reproductive problems, which were reversed when a substance from wheat germ oil was added.
1937	Krebs cycle, also called tricarbox- ylic acid cycle	Hans Adolf Krebs	Discovered biochemical pathway for energy production within cells.
1941	The first Recommended Dietary Allowances (RDA) were published	Food and Nutrition Board of the National Academy of Sciences	This is a first dietary reference intake in the world.
1948	The Framingham Heart Study: first Nutrition and Health Cohort Study	Thomas R. Dawber, Gilcin F. Meadors and Felix E. Moore Jr	Researchers began systematically tracking die- tary habits and health outcomes.
1980	The first official dietary guidelines were released	U.S. Department of Agri- culture (USDA) and the U.S. Department of Health and Human Ser- vices (HHS)	The Dietary Guidelines for Americans (DGA) initiative, which advocated for a low-fat diet.
2005	The 'Giessen Declaration': New Nutrition Science	International Union of Nutritional Sciences (IUNS) and the World Health Policy Forum	It focuses on the health of individuals, popula- tions and the planet.
2019	Sustainable healthy diets	FAO and WHO	Designing one's own diet by referencing dietary guidelines and combining traditional eating hab- its with current circumstances to create a suitable diet for oneself.
2000- present	Personalized nutrition or precision nutrition	Jim Kaput	Using advanced technologies such as multi- omics, microbiome analysis, data science, artifi- cial intelligence (AI) and machine learning to tailor dietary advice based on an individual's unique needs.

Table 1. Key discoveries/ events of the history of nutrition sciences



Figure 1. Milestones of nutrition science development

began to understand food—what was safe to eat, what was harmful, and what benefited the body. From these foundational concepts of nutrition to the sophisticated understanding of modern nutrition today, the field has evolved over tens of thousands of years (Table 1, Figure 1). As nutrition research continues to advance, leading to a better understanding of what and how much an individual should eat, the incidence of diseases will decline, and lifespan is expected to be significantly extended.

AUTHOR DISCLOSURES

No competing interests are reported.

REFERENCES

 Wang WF. The Dadiwan site bears witness to a prehistoric civilization dating back 8000 years. 2015/8/8; Available from: https://baike.baidu.com/reference/1321512/533aYdO6 cr3_z3kATPWDy_X4MiqWMI-t67fWAZzzqIP0XOpX5ny FJk77tYxsPBoAkXIvtdqdNsZ2br6C05apLBZNoI0QrUqgnf 8UjbB1-aiooU

- 2. Darby W, Ghaliongi P, Grivettill P. Food, the Gift of Osiris. London: Academic Press, 1977.
- McGovern PE, Mirzoian A, Hall GR. Ancient Egyptian herbal wines. Proc Natl Acad Sci U S A. 2009;106:7361-6. doi: 10.1073/pnas.0811578106.
- Bhavana KR, Shreevathsa. Medical geography in Charaka Samhita. Ayu. 2014;35:371-7. doi: 10.4103/0974-8520.158984.
- Ganz JC. Hippocrates (ca 460 BC to ca 370 BC). Prog Brain Res. 2024;284:31-48. doi: 10.1016/bs.pbr.2024.02.004.
- 6. Li D. Food Nutrition. Beijing: Chemical Industry Press; 2010. (in Chinese)
- Hosseinzadeh H, Nassiri-Asl M. Avicenna's (Ibn Sina) the Canon of Medicine and saffron (Crocus sativus): a review. Phytother Res. 2013;27:475-83. doi: 10.1002/ptr.4784.
- Drummond J, Wilbraham A. The Englishman's Food. Five Centuries of English Diet. London: Pimlico, 1991.
- Lovejoy A. The Great Chain of Being. Cambridge, MA: Harvard University Press, 2001.
- 10. Schmid R. Traditional Foods Are Your Best Medicine. New York: Ballantine, 1987.

- Robbins R. The Food Revolution. How Your Diet Can Help Save Your Life and the World. Boston, MA: Conari, 2001.
- Major RH. Santorio Santorio. Ann Med Hist. 1938;10:369-81.
- Wynder EL. A corner of history. James Lind's discovery of the causes of scurvy. Prev Med. 1974;3:300-5. doi: 10.1016/0091-7435(74)90039-5.
- Beaudry M. Think globally, act locally. Do dietitians have a role to play in alleviating hunger in the world? J Can Diet Assoc. 1985;46:19–27.
- 15. Jons Jacob Berzelius (1779-1848). JAMA. 1965;193:153-4.
- 16. Brouwer E. Gerrit Jan Mulder (1802-1880). J Nutr.
- 1952;46:3-11. doi: 10.1093/jn/46.1.1.17. Dawson PM. A Biography of Francois Magendie. Med Library Hist J. 1907;5:24-33.
- Trummert W. Justus von Liebig und Louis Pasteur. Also a contribution to German-French scientific relations in the 19th century-II. Munch Med Wochenschr. 1966;108:678-83.
- Verhoef J, Snippe H, Nottet HS. Christiaan Eijkman. First bacteriologist at Utrecht University, Nobel laureate for his work on vitamins. Antonie Van Leeuwenhoek. 1999;75:165-9. doi: 10.1023/a:1001751522263.
- 20. Van Leersum EC. The Discovery of Vitamins. Science. 1926;64:357-8. doi: 10.1126/science.64.1658.357.
- 21. Kruse HD. Citation and presentation of the Academy Medal to Elmer Verner MCCOLLUM. Bull N Y Acad Med. 1961;37:229-34.
- 22. Niki E, Traber MG. A history of vitamin E. Ann Nutr Metab. 2012;61:207-12. doi: 10.1159/000343106.
- Spector AA, Kim HY. Discovery of essential fatty acids. J Lipid Res. 2015;56:11-21. doi: 10.1194/jlr.R055095.
- 24. Raju TN. The Nobel chronicles. 1953: Hans Adolf Krebs (1900-81) and Fritz Albert Lipmann (1899-1986). Lancet. 1999;353:1628. doi: 10.1016/s0140-6736(05)75758-5.

- 25. Dawber TR, Meadors GF, Moore FE Jr. Epidemiological approaches to heart disease: the Framingham Study. Am J Public Health Nations Health. 1951;41:279-81. doi: 10.2105/ajph.41.3.279.
- 26. Menotti A, Puddu PE. Ancel Keys, the Mediterranean Diet, and the Seven Countries Study: A Review. J Cardiovasc Dev Dis. 2025;12:141. doi: 10.3390/jcdd12040141.
- 27. Keys A, Anderson JT, Grande F. Serum cholesterol in man: diet fat and intrinsic responsiveness. Circulation. 1959;19:201-14. doi: 10.1161/01.cir.19.2.201.
- Dietary reference intakes. Nutr Rev. 1997;55:319-26. doi: 10.1111/j.1753-4887.1997.tb01621.x.
- 29. United States Department of Agriculture, United States Department of Health and Human Services. Nutrition and your health: dietary guidelines for Americans. Washington (DC): Government Printing Office; 1980.
- International Union of Nutritional Sciences. The Giessen Declaration. Pub Heal Nutr. 2005;8:783–6. doi: 10.1079/phn2005768.
- Beauman C, Cannon G, Elmadfa I, Glasauer P, Hoffmann I, Keller M, Krawinkel M, Lang T, Leitzmann C, et al. The principles, definition and dimensions of the new nutrition science. Public Health Nutr. 2005;8:695-8. doi: 10.1079/phn2005820.
- 32. FAO and WHO. Sustainable healthy diets Guiding principles. ISBN 978-92-5-131875-1 (FAO); ISBN 978-92-4-151664-8 (WHO), 2019.
- 33. Kaput J. Decoding the pyramid: a systems-biological approach to nutrigenomics. Ann N Y Acad Sci. 2005;1055:64-79. doi: 10.1196/annals.1323.011.
- 34. Li D. Precision Nutrition. In: Gallegos D, Wattanapenpaiboon N and Wahlqvist ML, eds. Food and Nutrition, 5th ed. London: Taylor and Francis Group, 2025.