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Origins and evolution of the National Nutrient Databank Conference

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Abstract

Food composition tables are largely a twentieth century product. The early tables in America developed by W. O. Atwater in the 1890's at the Storrs Connecticut Agricultural Experiment Station grew exponentially during the first half of the 20th century as one after another vitamin and mineral was found to be essential for life. As tables became more complex the user required better tools for calculating food composition. The rapid growth of computer applications in the mid to late 20th century allowed nutritionists to access these complex tables. This confluence of data and computer applications spawned an organization created specifically to study food composition databases.

Peer-review under responsibility of the National Nutrient Databank Steering Committee

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1. Introduction

The National Nutrient Databank Conference evolved to satisfy a need in the nutrition community. In the 1970's the accumulation of dietary data over the previous 80 years had resulted in massive databases too big for manual calculations. But fortunately emerging automatic computer capability was becoming available. The potential for automated nutrient calculations was eagerly anticipated by practicing nutritionists but combining the two technologies did not solve all the old problems, and contrary to expectations it created new ones.

By lucky happenstance a group of dedicated workers in government and clinical nutrition came together to form an organization to study and campaign for strategies to resolve the evolving issues, and that organization has lasted for over 40 years. Two newcomers to the field of computer applications, a physician (Dr. Donough O'Brien) and a dietitian, (Ms. Joan Karkeck) were catalysts for the meeting that led to an annual conference. Their pleas were heard by others and the combined interests of numerous specialists eventually led to an organization called the National Nutrient Databank Conference or NNDC. But to fully appreciate how such a long lasting organization could emerge from seemingly random encounters we need to go back a couple of centuries. The following historical snapshot suggests that the time was right in 1976 for developers and users of nutrient data to step forward.

2. Identifying and Documenting Food Composition

The tremendous amount of food composition data we take for granted today was not always available. In 300 BC Hippocrates ventured the notion there was one element in food that nourishes. He based this idea on the observation that people living near the sea ate exclusively food from the sea and were healthy, yet those living inland were just as healthy living only on food from the land. Therefore, logically, there must be something in all foods that nourishes. Nothing is reported to confirm this observation for almost 2000 years. Fast forward two centuries when we find records in at least three different European countries documenting multiple nutritional components in food identified by a new science, chemistry.

In 1827 England William Prout, working in the fledgling field of chemistry, identified three primary components of food he termed saccharinous, albuminous, and oliginous (for carbohydrate, protein and fat) to describe the components he identified in food.

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Unfortunately physiologists dominated the medical field in England at that time and they were not receptive to new ideas from chemistry, a rival field. Prout predicted that chemistry would eventually transform medicine, that knowledge of chemistry would be as valuable to the physician as anatomy was to the surgeon.[1] He did not live long enough to see his prediction come true, but others who came after him proved him right. More established chemists in France and Germany were also working in this new field, known as "nutrition", and they received a more receptive audience. Antoine Lavoisier in France[2] and Justus Von Liebig in Germany[3] were conducting experiments to measure changes occurring as food was converted to energy in the body. Protein was considered the primary source of energy for conducting work.

Timing and ambition were just right for an industrious and talented son of a Methodist minister in America in the late 1800's to begin working in the field of nutrition. Wilbur Olin Atwater was born in New England in 1844 and by 1885 was a chemistry professor at Wesleyan University in Middletown Connecticut. By this time he had studied in Europe primarily with Carl Voit in Germany (a protégé of Liebig). Atwater's ambition was to study nutrition among American workers with the goal of recommending the most economical diet[4]. Nutrition thinking of the time was that protein was needed to provide energy but protein sources were the most expensive food items, and food already consumed over half the worker's income. Atwater was convinced he could improve the economy of the American family by studying their food intake and expenditure and recommending a thrifty diet. From his studies in Germany he was well versed in the tools needed to conduct studies in America. With his knowledge and ambition he was a natural choice to lead the newly formed Agricultural Experiment Stations in America.

But the road to science was a bumpy one as explained by Judy McBride in an Agricultural Research Magazine[5], She wrote "In early 1893, the odds that Wilbur Olin Atwater would get public support for his grand plan for food investigations were slim to none". His eventual success in attracting funding was attributed to intercession of Edward Atkins of Boston who was a close personal friend of the Secretary of Agriculture who would decide funding, and Atkins was well aware of Atwater's potential contribution to food economy. Atkins was a self-taught economist who published widely on economic issues and understood what Atwater could add to the current knowledge about food economy. He encouraged the Agriculture Secretary to fund human nutrition research in America. In McBride's words, this recommendation was instrumental in "prying open the door for the first federal funding of human nutrition research in the United States". But Atwater himself had to pursue this recommendation vigorously for another year before he was finally granted $10,000 for food investigations. Atwater established a laboratory at the Storrs Connecticut Experiment Station and began his studies, which fortunately attracted attention from other sources of funding; the National Fisheries contracted for a study of the composition of fish and the Smithsonian Institute provided funding for other food analyses.[6]

This led to the first comprehensive food composition table, probably in the world. Earlier food tables were limited by the available data which was largely inorganic constituents and organic acids[7]; the Atwater tables were comprehensive (5 components, the "proximates") for hundreds of foods.

The variety of foods in the tables was so great that Atwater was later able to supervise nutrition studies all over America. The first table was published as USDA bulletin 21 in 1895. This document contained detailed descriptions of sample preparation and observations on characteristics of food in different stages of preparation plus data on protein, fat, moisture and ash plus carbohydrate by difference (the "proximates") for selected foods. The next year a comprehensive summary of all the food analysis data was compiled by Atwater and CD Woods and published as Bulletin 28, also by the USDA Experiment Station[8]. This work is mentioned in detail because it represents an amazing accomplishment in such a short time. Food composition data available before this had taken centuries to be developed. Atwater was simply at the right place at the right time and had the conviction of purpose to grab the opportunity and exploit it. Comprehensive tables were later developed in the U.S. and other parts of the world. Notable were Bowes and Church in the U.S.[9] and McCance and Widdowson England[10] during the 1930's and Souci in Germany[11] in the 1960's. Today the Food and Agriculture Organization of the United Nations lists dozens of food composition tables from countries around the globe (http://www.fao.org/infoods/infoods/tables-and-databases/en/).

Analyzing food and developing a table of food composition depends on the technology available. In the 1890's Atwater fashioned equipment needed for this work including a bomb calorimeter for measuring energy in food and a room-sized calorimeter to measure human energy expenditure. He conducted or directed the analyses of numerous food stuffs and quickly became aware of the variability in the composition of food caused by factors such as cut of meat and recipe for prepared foods. He took advantage of the World's Fair in Chicago in 1893 to acquire samples of meat for analysis from all over the world. As data on food composition became available, for the first time it was possible to calculate the energy required by a person at work in their natural environment from a record of food intake. While this was of scientific interest, it was not of immediate public value, so Atwater was pressed to show more relevance to his work. He was assigned broader responsibilities, which included supervising nutrition studies in all the experiment stations to bring this science to a wider audience[4]. Tabulating this data was time consuming, but with only six components to manipulate pencil and paper and a mechanical calculator was sufficient for scientific work.

However, between 1910 and 1940 many more nutritive components were identified and measured. Table 1 gives a snapshot of the growing list of known nutritive components in food. In 1963, after reviewing available data, the USDA Agricultural Research Service published the most relevant information in a booklet called "Handbook 8, Composition of Foods" with data for 2483 foods for 20 components. The foods were listed in 100 g portions which hampered wide usage, but nonetheless the data were utilized for many purposes including menu planning, research, and education.

3. Computerizing Food Composition Databases

Concurrently there was rapid development of electronic devices for manipulating numbers. The first computers available for manipulating food composition data were housed in government, academic and industry and were room-sized to be shared by many