This work was completed on behalf of the European Food Information Resource (EuroFIR) Consortium and funded under the EU 6th Framework Food Quality and Safety thematic priority. Contract FOOD-CT-2005-513944.

EuroFIR
www.eurofir.net

The History of European Food Composition Databases

By Susan Church
Independent Public Health Nutritionist

Acknowledgements

The author *Mrs Susan Church* is grateful to the numerous people who have helped during the preparation of this report, including:

- National food composition database compilers and EuroFIR participants for contributions on European milestones in the history of food composition databases.
- Reviewers of the text, including Dr Barbara Burlingame, Mr Anders Møller, Ms Alison Paul, Professor David Southgate and staff at the British Nutrition Foundation.

The History of European Food Composition Databases

By Susan Church
Independent Public Health Nutritionist

Contents

Introduction 3

What are food composition databases and why are they needed? 5

Evolving requirements for food composition tables 6
- Nutritional epidemiology and assessment of nutritional status 6
- Nutrition education and health promotion 8
- Formulation of specific diets 8
- Food trade and industry 9
- Changing food supply 10

Key events in the development of food composition databases 12
- First milestones 12
- Early American tables 13
- FAO tables for international use 14
- History of the British food composition tables – a case study 15
- Other European milestones 20

Products – changes over time 38
- Printed tables 38
- Electronic formats 38
- Added-value products 39

Networks and cooperations 41
International Network of Food Data Systems (INFOODS) 41
EuroFoods and FLAIR EuroFoods Enfant Project 43
COST Action 99 45
EFCOSUM 46
Where are we now? 47
EuroFIR 48

Future developments 50

References 51

Introduction

This work was completed on behalf of the European Food Information Resource (EuroFIR) Consortium and funded under the EU 6th Framework Food Quality and Safety Programme, project number FP6-513944.

EuroFIR, the world-leading European Network of Excellence on Food Composition Databank systems (www.eurofir.net) is a partnership between 40 universities, research institutes and small-to-medium sized enterprises (SMEs) from 21 countries. EuroFIR aims to develop and integrate a comprehensive, coherent and validated databank providing a single, authoritative source of food composition data for Europe.

This report:

- Outlines what food composition tables are and why they are needed
- Describes key events in the development of food composition databases
- Provides examples to illustrate how requirements for food composition data have changed over time, using the UK food composition tables as an example
- Discusses some of the products developed from food composition databases and how these have changed to reflect user requirements

- Outlines the international cooperations and networks in the field of food composition
- Considers possible future developments

What are food composition databases and why are they needed?

Food composition databases provide detailed information on the concentrations of nutrients and nutritionally important components in foods. They have a wide variety of uses including:

- Assessment of health and nutritional status at individual, regional, national and international levels
- Formulation of appropriate institutional and therapeutic diets, including schools and hospitals
- Helping to identify nutrition education and health promotion needs
- Food and nutrition training
- Epidemiological research on relationships between diet and disease
- Devising nutrition labelling
- Food product and recipe development
- Monitoring the nutritional value, safety, and authenticity of foods for food trade, and consumer protection and information
- Improvements to the food supply, such as plant breeding, and new methods of cultivation, harvesting and preservation

Evolving requirements for food composition tables

"A knowledge of the chemical composition of foods is the first essential in the dietary treatment of disease or in any quantitative study of human nutrition" (McCance and Widdowson, 1940).

i) Nutritional epidemiology and assessment of nutritional status

This often quoted remark indicates the original motivation behind food composition studies, which were carried out to identify and determine the chemical nature of the food components that affect health and the mechanisms whereby chemical constituents exert their influence (Greenfield and Southgate, 1992; 2003). Such studies remain central to nutrition research into the role of food components and their interactions in health and disease, but at an ever-increasing level of sophistication and complexity.

In particular, the increase in research into the relationship between diet and chronic disease has led to increased demand for complete, current and reliable food composition tables, and for information on a far greater variety of food components, including bioactive compounds. International epidemiological studies, such as the European Prospective Investigation into Cancer and Nutrition (EPIC), have highlighted the need for

harmonisation and standardisation of food composition data produced at a national level (Deharveng *et al*., 1999; Charrondiere *et al*., 2002). These national data are not currently compatible because of differences in, for example, food description and classification, nutrient definitions, methods of analysis, units and modes of expression.

With the growing recognition of the effects of diet on health, many countries have developed national programmes to assess diet and nutritional status at a population level. In many countries, these programmes have provided the impetus needed for continued support of food composition work. In addition, numerous smaller dietary surveys are undertaken, for example to assess nutritional status at a local level or in specific population sub-groups. These may require food composition data specific to the sub-group being studied (e.g. traditional or ethnic foods).

Epidemiological researchers and those assessing nutritional status at a population level have particularly benefited from the development of computerised databases. These can not only hold a much greater volume of data compared with printed tables, but hugely facilitate the manipulation of data, both in terms of adding new values and for the calculation and analysis of nutrient intakes.

ii) Nutrition education and health promotion

The evidence from epidemiological studies and national assessments of nutritional status have led to increasing guidance and education programmes on choosing a healthy diet. Food composition data provide the foundations for such guidance, which includes nutrition labelling information.

iii) Formulation of specific diets

Nutritional issues related to specific diseases, population sub-groups or specific situations were an early driver for studies into the composition of foods. For example, it is believed that some of the very earliest work related to assessing food supply in prisons. Some of the first UK work was in response to food shortages during the First World War, while work during the 1920s in the UK was initially prompted by an interest in the treatment of diabetes.

Use of food composition data in the development of therapeutic diets (e.g. to treat obesity, diabetes, nutritional deficiencies, metabolic disorders, food allergy and intolerance) has been facilitated by advances in information technology, and, in particular, the production of nutritional analysis and meal planning software. Food composition data have also become increasingly important for planning institutional diets (e.g. schools, hospitals, prisons, day-care centres) as the links between diet and health have been recognised. Recent

examples include the focus on school meals as concerns over children's diets and health (e.g. obesity) have grown.

iv) Food trade and industry

Increasing international trade has led to a greater need to access data for foods from other countries. For example, governments need to know the composition of imported foods in order to ensure the nutritional value and safety of the diets available to their populations. Similarly, food retailers and manufacturers need to know the composition of foods or ingredients imported, for example to meet food labelling requirements or national standards and regulations. At an international level, standards such as Codex Alimentarius utilise food composition data.

Nutrition labelling of foods is now common, and indeed is mandatory in some instances. This development has largely been driven by the demand for point-of-purchase information to ensure that consumers can make an informed choice. The use, where appropriate, of 'authoritative' composition data taken from compilations such as national food composition databases is often permitted as an alternative to direct analyses of products, to calculate nutrient values for food labelling purposes. This is the case in Europe. As well as hugely expanding the user base for food composition databases, this development has also had implications for the production of databases, since it strengthens the need for current, reliable

and representative data. This has influenced research into, and the presentation of, food composition data in most European countries.

Food manufacturers also use food composition data when developing new products; data are particularly relevant to the development of 'healthier' ranges of processed foods which must meet specifications for amounts of fat, sugar and/or salt.

v) Changing food supply

Diets worldwide have changed dramatically over the years since the first food composition data were produced. The food supply is now more dynamic than ever. Trade is undertaken on a global level, which has major implications for the foods consumed within each country. For example, exotic fruit and vegetables, and indeed new varieties of indigenous produce, are now commonly available around the world, often all year round. The diverse-ethnic populations in many countries have brought with them their own food cultures, and increased the diversity of food outlets in the host country. Processed foods are widely consumed and their numbers and diversity are continually increasing. New ingredients and new processing methods have been developed and, more recently, there has been increasing interest in functional foods. To attempt to meet user requirements for data which reflect dietary habits, food composition databases have greatly expanded in terms of numbers of foods., Few national authorities, however, have had

the resources to keep pace with all the developments/advances in today's food supply.

Key events in the development of food composition databases

First milestones

It is likely that the first food composition table, in the form of a 'nutrition scale', was produced as early as 1818 (Somogyi, 1974; Percy & Vaquelin, 1818). This appears to have arisen from investigations in connection with the food supply in prisons.

Reference has also been made to European analyses of milk, by Boussingault and Le Bel; reported in 1831, and analyses of 'a considerable number of foods' by Leibig, Playfair and Boeckman in the 1840s (Atwater and Woods, 1896).

Food composition tables in the format known today were, however, not published until towards the end of the 19th century. The first European food composition table was published in Germany in 1878 (Konig, 1878). Germany was one of the chief authorities on food composition, in Europe and beyond, for some years after publishing these tables (Atwater and Woods, 1896).

Early American tables

Perhaps more widely known among the earliest tables are those published in the United States in 1896 (Atwater and Woods,1896). A copy can be viewed on the USDA website (http://www.nal.usda.gov/fnic/foodcomp/Data/Classics/index.html).

Up until about 1880 American researchers relied on analyses of European products, mostly undertaken in German laboratories, for information on the nutritional value of foods (Atwater and Woods, 1896). The first extended series of investigations of American food products (on fish) was undertaken between 1878 and 1881, by Atwater. Over the next few years, analyses were undertaken on a range of food samples by various researchers, including grains and vegetables, by Jenkins and Winton. The largest study was performed "at the instance of the World's Columbian Commission, under the direction of Professor Atwater. Some five hundred specimens of food products collected at the World's Fair were analysed" (Atwater and Woods, 1896).

The resulting tables incorporated nearly 2,600 analyses of a wide range of foods, from all the main food groups (e.g. meats, cereals, fruit and vegetables) but also included processed foods such as chocolate, sausages, and crackers. Values were presented for 'refuse', water, protein, fats, carbohydrates (by difference*), ash, and 'fuel value'. A later edition (Atwater and Bryant, 1906) also included separate crude fibre values.

**Calculation of carbohydrate content by difference; the amount left after subtracting the amount of water, protein, fat and ash from the weight of the food.*

FAO tables for international use

An interesting milestone in food composition was the publication of 'Food composition tables for international use' by the Food and Agriculture Organization (FAO) in 1949 (Chatfield, 1949). These tables were produced in order to assess food availability at the global level, using Food Balance Sheets. This assessment included the calculation of the energy, protein and fat availability, on a per caput basis. Although it was recognised that national tables were more accurate for this table, such tables did not exist for most countries at that time. The use of internationally prepared tables was therefore considered justified as a practical tool for assessing the nutritional value of food supplies. These first tables included values for water, calories, protein, fat, carbohydrate (total, by difference, and crude fibre) and ash. These tables were followed by a second set in 1954, giving values for minerals and vitamins (Chatfield, 1954).

FAO continued its activities in the food composition area, producing regional food composition tables for Asia, Africa, Latin America and the Near East in the 1960s and 1970s, then reduced its work in this arena. However, recognising the need to enhance the quality and increase the quantity of food composition data, FAO reinstituted its food composition work in

the early 1990s, in partnership with the United Nations University International Network of Food Data Systems (INFOODS) project, focusing on strengthening national efforts to produce such information (see page 41).

History of the British food composition tables – a case study

The British food composition tables provide a good example of how food composition tables have evolved over time to meet changing requirements. In addition they show how principles developed in the early days of food composition tables have persisted through the years, and are now embedded within the data collection and compilation processes.

Although the UK has been widely seen as a leader in the field of food composition databases, the first UK developments came many years after tables had been produced in Germany and the United States (Widdowson, 1967; Widdowson, 1974; Southgate, 1993). Work in the UK can be traced back to the First World War (1914-1918), when concerns over food shortages led to the British War Office directing Captain Plimmer, a chemist serving in the Army, to undertake analyses of common British foods. Values for water, ash, protein, carbohydrate (sugars analysed, starch calculated) and fat were determined, in duplicate where possible, for 900 foods. In addition, many foods were analysed for their fibre and sodium chloride content. The resulting tables were published in 1921 (Plimmer, 1921).

About this time Dr R.D. Lawrence, of King's College Hospital, London, and a medical student, R.A. McCance, became interested in the treatment of diabetics and the calculation of food values of fruit and vegetables, the mainstay of diabetic diets. There were a number of problems with the existing carbohydrate values, which were calculated 'by difference':

- they did not distinguish between available carbohydrates and unavailable, indigestible carbohydrates;
- when calculating carbohydrate by difference fibre was often measured separately;
- values could be very variable, depending on the source of the data.

In 1925, McCance was awarded a grant by the British Medical Research Council, which enabled him to analyse cooked and raw fruits and vegetables for available carbohydrates (McCance & Lawrence, 1929). The importance of direct determination of carbohydrates, rather than calculation 'by difference' is a principle still followed in British food composition studies.

This work was extended to a detailed study of the composition of meat and fish, including protein, fat and minerals (McCance & Shipp, 1933). Elsie Widdowson joined the team as a new study on fruit and vegetables began, extending the previous work on carbohydrate content to protein, fat and minerals (McCance, Widdowson & Shackleton, 1936). From her contacts with dietitians and dietary surveys that she had undertaken,

Widdowson realised the need for comprehensive tables of the composition of British foods (Widdowson, 1967). Analyses were therefore further extended to cereal foods, dairy products, and items such as beverages, preserves, and confectionery. All the analyses were brought together in the first edition of what later became *The Composition of Foods* (McCance & Widdowson, 1940).

Unusually for that time, the tables included the composition of many cooked foods and cooked dishes, the latter being derived by calculation together with recorded weight loss on cooking. This new practice of including foods in the forms in which they are eaten (as well as in the raw form) has continued through subsequent editions.

In addition, rather than analysing each sample of food individually and then calculating an average, one composite sample (which included a number of different sub-samples) of each food was analysed. This approach reduced the amount of work required, and, while not giving information about variation, provided representative figures for the food. Even now, the UK's nutrient analysis programme uses this same approach for most analyses, only undertaking analyses on several samples of single foods where there is a specific requirement for data on variation.

The nutrients and components in this first edition included: water, available carbohydrate, sugar, starch and dextrins, unavailable carbohydrate, total and purine nitrogen, protein, fat,

energy (kilocalories), inorganics (sodium, potassium, calcium, magnesium, iron, copper, phosphorus, sulphur, chloride), edible matter and acid-base balance.

A second edition followed in 1946, incorporating foods consumed during the war and post-war years (McCance and Widdowson, 1946). The third edition (McCance and Widdowson, 1960) was extended to include the processed foods that were becoming increasingly important in the diet, and also values for vitamins and amino acids. About 100 new foods were analysed. However, because of the wealth of information already available on the vitamin content of foods, it was decided to include previously published values in the database for the first time, rather than analysing every food for every vitamin. The importance of thorough evaluation and maintaining high standards of documentation were therefore very apparent in this edition. Auditing of values and the inclusion of appropriate documentation are, of course, still part of the compilation process, but developments in information technology mean that documentation is now more easily accessed.

A partnership between the Medical Research Council, the Ministry of Agriculture, Fisheries and Food (MAFF), and the Laboratory of the Government Chemist (for analyses) was formed to produce the fourth edition (Paul and Southgate, 1978). This edition was needed primarily because of the constantly evolving and increasingly diverse diet of the UK population, and the many new or improved processed food products available. Work on this edition was led by David

Southgate and Alison Paul, with Elsie Widdowson still keeping an active interest, providing continuity of the sound principles on which the tables are based. In recognition of their special contribution to nutrition composition research, McCance and Widdowson's names were incorporated into the title of this and subsequent editions of the tables.

The fourth edition was prepared with computerised databases in mind and, for the first time a computer-readable tape was made available at the same time as the printed book was published, in 1978. (Dr J Durnin and D Miller had also produced computerised versions of the third edition, primarily for their own use.) Although the 28 reels of paper tape required further editing by users (Day, 1985), they were another important milestone in the evolution of the tables, and marked a gradual move away from printed tables and towards electronic formats including nutritional analysis software.

Following the publication of the fourth edition, MAFF, and subsequently the Food Standards Agency on its formation in 2000, took on responsibility for maintaining and updating the UK food composition tables. Fifth and sixth summary editions (Holland *et al*., 1991; Food Standards Agency, 2002) and a range of food-group specific (e.g. fruit and nuts) and other nutrient-specific supplements (e.g. fatty acids) (details given in Food Standards Agency, 2002) were published. The data were, of course, already a working tool for nutritional research and were used in government dietary and household expenditure surveys (e.g. MAFF's National Food Survey). The launch of a

series of detailed national diet and nutrition surveys (the Dietary and Nutritional Survey of British Adults and the National Diet and Nutrition Survey programme) was perhaps one of the factors responsible for a shift in emphasis for nutrient analysis programmes. They are now designed to directly support these food consumption surveys. The food composition tables a by product, published to ensure wide dissemination to the many users of the data.

Other European milestones

As well as Britain, many other European countries were also early pioneers in the field of food composition. Milestones in many European countries are given below. This information is not comprehensive but is intended to provide examples of how food composition work has evolved in a selection of different countries.

Austria

Austria does not have its own food composition database. Instead, the German food composition tables are used, because dietary patterns are similar.

Belgium

From 1985 onwards data were collected in Belgium from different sources including; analytical values, data from the food industry, food distribution data and data from scientific literature. These data were compiled into a food composition table and first published in 1992 by NUBEL vzw. and updated in 2004 (Nubel; 1992, 1995, 1999, 2004). Nubel (meaning NUtrition BELgium) is a non-profit organisation responsible for the management of the national food composition data in Belgium and has established a partnership between public and private sectors. Nubel has prepared a special on-line edition of brand-name foods at http://www.internubel.be (fees charged).

Bulgaria

The first Bulgarian food composition table was published in 1966. It included 918 foods including non-alcoholic beverages and covered macronutrients, vitamins and minerals. The origin of the data was mostly foreign (borrowed data). In 1975, the second edition of the Bulgarian food composition tables was published, with 749 foods and an extended range of nutrients. From 1996 consolidated data has been included in an electronic Bulgarian food composition database, containing information for 762 products. Data for 362 foods are based on analysis for macronutrients, minerals and amino acids, with borrowed data for vitamins and fatty acids, while values for a further 436 foods were calculated from recipes.

Croatia

The Nutrition Department of the Croatian National Institute of Public Health has been involved in food composition activities for more than 30 years. During this time several editions of food composition tables were printed: 1965, 1969, 1976, and 1990. The latest edition (1990) is also available in electronic form.

Cyprus

The Ministry of Health State General Laboratory is responsible for food composition data in Cyprus. The second edition of the Cypriotic food composition table was published in 1999 (Yiannopoulos *et al*., 1999). Values are derived solely from analyses; this was possible due to Cyprus being a small island with limited sources of food production. Work is now underway to expand the range of foods and components.

Denmark

The history of the Danish food composition tables can be found at http://www.foodcomp.dk/fcdb_fooddatahistory.asp.

Reviews of food composition have been published since 1888, and the first known tables (Jürgensen, 1888) can be downloaded from the above website. This work is considered to be the first systematic overview of the nutrient composition of

Danish foods, with information on protein, fat and carbohydrate. Tables incorporating information on vitamins, and intended for education in home economics, were published in 1932 (Dam and Ege, 1932), with further publications by Ege between 1941 and 1970. Tables based on 'scale levels', representing the range of variability for each component, were also published (Groth-Petersen, 1940). During the 1970s, Peder Helms published a series of tables and, in 1978, he changed the appearance of the composition tables from being manageable tables intended for education into tables with one page per food and an indication of the content of more than 50 nutrients (Helms, 1978). This laid the foundation for the establishment of a database of nutrients in Danish foods. The first official table was published in 1983 (Møller, 1983). About two-thirds of the data in this table were based on analyses of Danish foods. Further editions of the Danish Food Composition Tables were published in 1985, 1989, and 1996. Since 2002, the Danish Food Composition Databank has been presented on-line (http://www.foodcomp.dk/fcdb_default.asp) in Danish and English, with free access.

Estonia

Estonia does not have a national food composition table. The Estonian food composition database contains nutrient data mostly from Finnish and Swedish databases, but also contains Russian and USDA data, as well as labelling information and data calculated from recipes.

Faroe Islands

Like Iceland and Greenland, the Faroe Islands have foods genuine to the Atlantic Ocean islands. In 1995, the first Farovian food composition tables, Føroyskar Føðslutalvur, were published by Heilsufrøðiliga Starvsstovan in Thorhavn, Faroe Islands.

Finland

In Finland, there has been a long-standing interest in food composition, with tables, based mainly on food analyses carried out in Finland, published since 1952 (West, 1985) and used in nutrition education. The national food composition database, Fineli, was established at the National Public Health Institute in 1984 as part of the Alpha-Tocopherol Beta-Carotene (ATBC) Cancer Prevention Study. Information on 48 components and 1800 foods is available free of charge on the internet (http://www.fineli.fi/) in Finnish, Swedish and English.

France

In France, tables were published from the 1950s onwards but following a revision of the Randoin tables (Randoin *et al.*, 1961), they were based upon published data (West, 1985). An analytical programme began during the 1980s, with a new table, containing 572 foods, published in 1991, followed by a second edition, containing 800 foods, in 1985. Le Centre Informatique

sur la Qualité des Aliments (CIQUAL), which is part of the French Food Safety Agency (l'Agence Française de Sécurité Sanitaire des Aliments), is responsible for maintaining the food composition tables.

Germany

Following the early pioneering work on food composition in Germany, the first edition of the comprehensive Souci, Fachmann and Kraut tables was published in 1962. The sixth edition of these tables were published in 2005. The Souci-Fachmann-Kraut tables are available on-line at http://www.sfk-online.net/cgi-bin/sfkstart.mysql?language=english (fees charged).

The Bundeslebensmittelschlüssel (BLS) started in 1988, and was the basis for the first German National Food Consumption Survey. It is intended for use in epidemiological studies and thus has no missing values. It also covers a greater range of foods (about 11,000). It is available on-line with limited controlled access.

Greece

The first edition of the Greek composition tables was published in the form of a booklet circulated to hospitals and other institutions in 1982 (Trichopoulou, 1982). This book was based on a study of recipes used by a large Athens hospital and the boarding-house of a visiting nurses' school in the capital, and was undertaken by

the Athens School of Hygiene. A second edition, in 1992, revised and expanded the data, to include 114 Greek cooked foods and dishes, for energy and 27 nutrients. The data in these two editions were derived from UK food composition data. However, the third edition, published in 2004, included, in addition and for the first time, data presented from the chemical analyses of selected traditional Greek foods and dishes. More information on the latest Greek food composition tables can be found on the Internet – http://www.nut.uoa.gr/english/Food_Comp_Tables/Food_Comp_Tables_EN.htm Similarly, data for Cretian foods have been published (http://nutrition.med.uoc.gr/GreekTables/index.htm).

Greenland

As part of a general investigation into the Greenlandic nutritional status, a table on the nutrient content of the most common foods in Greenland was published in the 1950s. The tables contain nutrient information on foods eaten by the Inuit and Danish populations.

Hungary

Work to establish a computer-based information database for food composition and nutrition data began in the early 1990s. In 1998 the 2nd edition of the Hungarian Nutrition and Food Composition Table, compiled and edited by Gy. Bíró and K. Lindner, was published.

Iceland

Iceland has tables dating back to the first Danish tables, as the first author of the Danish tables, Chr. Jürgensen, also produced publications in Iceland. Extensive work on Icelandic food composition has been carried out since the 1980s. The first official Icelandic food composition tables were published in 1988 and several editions have been published since then. The Icelandic data are available as pdf-files at http://www.iti.is/page.asp?id=1076 and an on-line database will be available in the autumn of 2005.

Israel

The first nutritional database in Israel was developed by J. K. Guggenheim in 1956. He based his first edition of nutrition composition tables on the USDA database with additional laboratory analyses in The Hebrew University in Jerusalem. Further editions were published until 1985.

In 1996, the Ministry of Health (Reshef and Meir) published a book of nutrition composition tables that included most of the Israeli foods at the time. The food composition data were based on the US and UK tables with additional local laboratory tests of certain items.

The book was updated and computerised for the analyses of the first Nutrition and Health Survey of the Israeli population (MABAT survey) in 2002.

Italy

The first food composition tables in Italy were compiled in 1946 by the National Institute of Nutrition (Istituto della Nutrizione, 1946), using data from analyses carried out by the Institute and data from the literature. Several updated editions followed, the latest being published in 2000 and available on the web (http://www.inran.it/Documentazione/tabelle.htm). Due to the need for information about a growing number of nutrients and food components, a project funded by the Italian Association for Cancer Research (AIRC, Milan) led to the publication, in 1998, of a database (The Food Composition database for Epidemiological Studies in Italy (www.ieo.it/italiano/ricerca/banca%20dati.htm), compiled from the Italian food tables with additional data from foreign food tables and scientific papers. The database is presently the base for the analyses of large epidemiological studies in Italy and it is currently being updated.

Latvia

The Food and Veterinary Service is responsible for food composition data in Latvia. The history of Latvian food composition data is fairly new and comprises data collected within certain monitoring programmes and specific research projects, including data on milk products (15 samples: nutrients, energy value, salt content; carried out by the Nutritional Council/Marketing Council) and vegetable oils (60 samples: safety criteria, quality criteria).

Lithuania

The National Nutrition Center of the Lithuanian Ministry of Health is responsible for food composition activity in Lithuania. Collaboration with FAO and Slovak colleagues began in 1995. The first volume of the national food composition tables, entitled Food Composition Tables – Energy and Nutrients, was published in 2002, and had information on 36 nutrients, energy and waste in unprocessed food items for over 300 primary foods and food products (e.g. vegetables, fruits and berries, potatoes and roots, breads and cereals, flour and pasta, fats and oils and milk and milk products). The second volume, published in 2005, includes information on soups, vegetable products, meat products, fish products, starchy and potato products, egg products, sauces and sweets. Data are derived from food composition tables from different countries (mainly Slovak, Polish, Swedish, and Russian), scientific materials published in Lithuania and reports from Lithuanian importers and manufacturers.

The Netherlands

The first Dutch food composition table was published in 1941 (Eekelen, Janssen, and Straub, 1941), using analytical data from The Netherlands and abroad. From 1941 to 1971, the Nutritional Council was responsible for compiling 25 food composition tables in total. In the first years all the information on food composition was written down on paper cards and kept

in a large wooden box. In 1971 the responsibility for the food composition table was taken over by a committee known as Dutch Food Composition Table ('Nederlandse Voedingsmiddelentabel' (NVT)) of the Nutritional Council. This committee published its last food composition table in 1989.

In 1972 the committee Uniform Coding of Food Consumption Surveys (UCV) started building an electronic database system with data on the nutritional value of foods used for processing food consumption surveys. As a foundation for this database the nutritional values of the NVT table were used, to which other nutrients and foods were added.

In 1985 the committee UCV became an independent organisation, the NEVO Foundation ('Stichting Nederlands Voedingsstoffenbestand'). In 1988 the NVT merged with the NEVO Foundation resulting in one central Dutch food composition database. From that time onwards the Dutch food composition table (NEVO table) has been compiled by the NEVO Foundation (http://www.nevo-foodcomp.nl/.)

Norway

The first official composition table in Norway was published in 1960 (Nutrition Council, 1960) and was primarily intended for use as a tool in nutrition education and related activities. The table contained data for energy and 13 nutrients (water, protein, fat, carbohydrate, calcium, iron, beta-carotene, retinol, thiamin,

riboflavin, niacin, ascorbic acid and vitamin D) for approximately 260 foods.

Collation of the data was started in 1954 when the Nutrition Council appointed a committee of five scientists whose aim was to plan individual dietary surveys. Such surveys were urgently needed as a basis for providing sound and relevant advice to various population groups as opposed to ideas in popular books written by international supporters of raw foods, vegetarianism, acid/base theories etc. A handwritten table with nutrient data and their sources was first prepared. The table was put together as a cooperative effort by several research groups who evaluated data from available sources; some even did their own analyses of foods that were poorly covered. The work was partly financed by the research groups who published their results as scientific papers, and partly by three governmental ministries (Fisheries, Agriculture and Social Welfare).

The first electronic database for calculation of nutrient composition from weighed dietary surveys was established in the early 1970s from punched cards.

Poland

The first official food composition tables in Poland were published in 1954 by Panstwowy Zakad Wydawnictw Lekarskich (Polish State Medical Publishers) (Rudowska-Koprowska, 1954). The author was Jadwiga Rudowska-Koprowska, a researcher

employed at the State Institute of Hygiene. A total of 336 foodstuffs were covered. Data were provided on the energy, water, total protein, fat, carbohydrates (as total and fibre), ash, calcium, phosphorus, iron, vitamins A, B1, B2, niacin and vitamin C content of 100 g of edible portion and 100g of marketed product of the foods. Data sources included the results of laboratory examination of the major food products covering groats, flours, cheeses, meat, offals and products, mushrooms, and some vegetables performed by the Department of Hygiene of Nutrition of the State Institute of Hygiene, together with data derived from literature. Many more editions have been published since, the latest in 2005, which included information on 82 components for 932 food products and dishes (Kunachowicz *et al*., 2005).

Portugal

The first food composition table in Portugal was published by the National Institute of Health in 1961 (Gonçalves Ferreria and da Silva Graça, 1961), following analytical work carried out within the Institute, on over 700 foods, including raw foods, canned foods and fruit preserves. All the values in the tables were obtained by direct analysis of the food samples. The work was prompted by the recognition of a lack of food composition data in Portuguese nutrition scientific literature and its importance in the medical and public health fields. Subsequent editions have been published and the data have also been incorporated into the Portuguese dietary analysis program PIABAD used for the conversion of food consumption data into nutrient intake data.

Russia

The Food Chemistry Laboratory at the Institute of Nutrition of Russian Academy of Medical Science, which was founded in 1970, is responsible for food composition work in Russia. A reference book on chemical components in more than 900 foodstuffs and more than 500 dishes was published in 1976 – 1984. The data were specified and corrected in 2002 and data on chemical composition of 430 new foodstuffs were published.

Serbia

A table was published in Serbia in 1976 (Brodarec, 1976) with further publications up to 1999. An electronic version of the food composition table was published in July 2005 by the Institute of Public Health Subotica, Nutrition Department. This food composition table was based on average content in food data from 28 different food composition tables in the world and results from analyses from Serbia. There are more than 1850 different foods with food composition provided per 100 grams for energy and a range of nutrients.

Slovakia/Czech Republic and the former Czechoslovakia

The first Czechoslovakian food composition tables, published in 1947 (Úlehlová-Tilschová, 1947), were based on scientific literature, taking into account the results of chemical analyses of

foods common at that time and produced in Czechoslovakia. Further tables of the nutritive value of foods were published in 1952, 1957 and 1965. Subsequent progress in this field was achieved at the Food Research Institute, Bratislava (Czechoslovakia up to 1992, Slovakia from 1993). An extensive database on food composition has been based on chemical analyses (undertaken during the 1980s) of foods produced and available on the Czechoslovak food market and supplemented with some literature data.

Since 1996, the Slovak Food Data Bank has been compiling data on food composition that reflects the current Slovak food market and dietary patterns. This is being made possible by particular cooperation with food producers, researchers working in the area of agriculture, universities and published literature. The database has been enriched with data from other literature sources; mainly unusual types of foods imported to the country (e.g. special species of fruits and vegetables).

The Czech Nutrition Society has published tables (Society for Nutrition, 1992) based mainly on literature data with some analytical results collected in the Czech Republic and Slovak Republic. Further tables on milk and milk products and fruit and vegetables were published in 2001, based on Czech analytical data and literature values. The Czech data are available free on-line (Czech with English food names) at http://www.chpr.szu.cz/dbdata/foodcomp/nut2001.asp. There is a co-operation agreement between the Food Research Institutes in Bratislava and Prague.

Slovenia

Food composition activities are coordinated by the Department of Food Science and Technology at the Biotechnical Faculty in Ljubljana. Two main food composition projects have been financed by the Slovene Ministry of Education, Science and Sport, the Ministry of Health, and the Ministry of Agriculture, Forestry and Food. There is also collaboration with experts from other Slovene research institutions. The first project, from 2001-2003, was to develop a Slovenian food composition database. Food composition data from research within the department were used, and limited analyses were performed for national foods. The database includes information on water, ash, fat, protein, and/or total carbohydrate for most of the 320 foods and beverages covered. The second project, from 2004-2006, is to develop Slovenian food composition tables for meat and meat products. The database is being compiled with new data and analytical work is focused mainly on meat of Slovenian origin.

Spain

Following the publication of a review of the recommended daily intakes of energy and nutrients in 1980, it was considered necessary to provide an up-to-date analysis of the composition of foods most commonly consumed in Spain. Initial tables were compiled from data collected from various sources within Spain, together with data from the literature (West, 1985). Tables by Olga Moreiras and colleagues (e.g. Moreiras *et al*., 1992) have now run to 9 editions.

One of the activities of the National Data Laboratory of the Center for Superior Studies in Nutrition and Dietetics (CESNID) is the development of a food composition database for the Spanish population. This database is available as tables (CESNID, 2003) and a CD-ROM with a nutrition software programme.

Sweden

The first Swedish food composition table was published in 1879 and included 161 foods and 5 nutrients. A more comprehensive 'official' table was published in the 1940s and included data from the National Institute of Public Health. Analysis of foods for a comprehensive Swedish food composition table began in the early 1960s, with the first edition of the National Food Administration's food composition table being published in 1978, with a revision in 1981 (Statens Livsmedelsverk, 1981). It included analytical data from in-house laboratories, food industry and international tables. The data were included in the first food composition database system, which was developed around 1980. The most recent printed table was published in 2002. In 2003, the Swedish food composition database was published on-line on the Internet (http://www.slv.se/ldb/), with free access.

Switzerland

For many years, Switzerland did not have a national food composition table and instead used internationally approved tables including the German and UK tables (West, 1985). However, in 1998, a project to produce Swiss food tables began, financed from both public and private money, and using nationally available data, foreign data, and, where necessary, analysis of nationally important foods. The Banque de Données Suisse de Composition des Aliments, which contains information on up to 36 constituents in about 700 food products, was published in 2002 in the form of PDF files (http://food.ethz.ch/swifd/).

Turkey

Turkey does not have its own food composition database. However, some data are available (e.g. data collected by the Agricultural Ministry in 1975, by the Turkish Dietitian's Federation in 1985, and calculated values and data on traditional foods (1992); data collected as the result of national and international research projects; data provided to the food industry for labelling). Data from German and US tables are also used, together with UK data and data from East Asian and African tables. A project proposal has been submitted for the preparation of a national food composition database.

Products – changes over time

Printed tables

Food composition tables were originally produced as printed versions, and for many years this remained the only format.

Food composition tables that have been produced or are available in Europe are listed on the INFOODS website (http://www.fao.org/infoods/tables_europe_en.stm). An inventory of European food composition databases and tables was also compiled as part of the COST Action 99 (see below) and can be found at http://www.langual.org/langual_literature.asp.

Electronic formats

While printed tables are still produced in most countries, computerised databases have become increasingly important because they can hold large amounts of data and allow easy access to and manipulation of data. Electronic formats range from ASCII (plain text), spreadsheet formats on disc, CD-ROMs and databases within on-line access. The British food composition tables were first made available on computer-readable tape in 1978. The US tables have been available on-line since 1996. Databases with on-line access within Europe are given in the sections above.

The LanguaL website currently provides information on databases available on-line, together with their associated links. http://www.langual.org/langual_linkcategory.asp?CategoryID=4&Category=Food+Composition.

This information will also be made available on the EuroFIR website in the near future (http://www.eurofir.org/foodlinks/), and will be regularly updated.

Added value products

As well as official versions of food composition tables in printed and electronic format, there are many other products based on, or dependent on, food composition data. Products are aimed at a wide spectrum of users, including consumers, health professionals and caterers. These include:

- abridged versions of tables, traditionally in a printed format, but more recently also for on-line access (e.g. calorie and carbohydrate counters);
- user-friendly formats (e.g. expressed per portion; in formats suitable for nutritional labelling);
- nutritional analysis software – a wide range of products, including products aimed at health professionals, education, food industry (labelling and product development), and caterers (menu planning);

- on-line nutritional analysis – more common in the United States but also available in Europe;
- novel products (e.g. food weighing scales that incorporate calorie counters).

Networks and cooperations

Food composition databases have generally been compiled as independent national activities to meet local requirements for calculating nutrient intakes. As a result, it has been difficult to use national datasets internationally and the results of costly food analysis programmes have not been fully exploited at an international level. There is, however, an increasing requirement for internationally compatible information. For example, with increasing international trade, there is a greater need to access data for foods from other countries. In addition, poor comparability between data in European countries impacts upon researchers' ability to undertake meaningful multi-centre nutritional epidemiology studies, and prevents the food industry from understanding and exploiting their products in the market place.

The recognition of the need to improve compatibility has led to the development of a number of cooperations and networks over the last 25 years.

International Network of Food Data Systems (INFOODS)

INFOODS was established in 1984 on the basis of the recommendations of an international group convened under the auspices of the United Nations University (UNU). Its goal was to stimulate and coordinate efforts to improve the quality and availability of food analysis data worldwide, and to ensure that

anyone anywhere would be able to obtain adequate and reliable food composition data (INFOODS website). From 1994, INFOODS was co-sponsored by the Food and Agriculture Organization (FAO) of the United Nations and since 1999, the secretariat has been based at FAO in Rome (http://www.fao.org/infoods/).

INFOODS activities include:

- provision of leadership and an administrative framework for the development of standards and guidelines for collection, compilation, and reporting of food component data;
- establishment and coordination of a global network of regional data centres directed toward the generation, compilation and dissemination of accurate and complete data on food composition;
- generation and repository of special international data bases;
- general and specific resources for persons and organisations interested in food composition data on a worldwide basis, including the Journal of Food Composition and Analysis, other publications, training and conferences.

INFOODS also initiated work to produce guidelines on the production, management and use of food composition data (Greenfield and Southgate, 1992; 2003). INFOODS reviewed users' requirements (Rand *et al*., 1987) and have led work on food descriptor systems and nutrient tag identification systems (a standardised approach to component names which is useful

in data interchange) (Truswell *et al*., 1991; Klensin *et al*., 1989).

Amongst the many regional networks, those covering Europe include:

- Eurofoods (see below);
- CEECFOODS: Central and Eastern Europe – Bulgaria, Croatia, Czech Republic, Hungary, Poland, Lithuania, Romania, Slovak Republic, Slovenia. A number of these countries are also participants in Eurofoods;
- NORFOODS: Northern Europe – Denmark, Finland, Iceland, Norway, Sweden, Greenland, Faroe Islands. NORFOODS is a project group, established prior to INFOODS in 1982, aiming to co-ordinate and render more effective work on Nordic food composition data, database systems and analyses of nutrients. Most of these countries are also participants in Eurofoods.

Eurofoods and FLAIR Eurofoods Enfant Project

A group of scientists, led by Dr Clive West, established Eurofoods in 1982 in recognition of the need to improve compatibility of food composition tables and nutrient databanks in Europe (West, 1985). A workshop was held in Wageningen, The Netherlands, in 1983 as a first step towards:

- increased and easier exchange of analytical data on food composition between the various countries in Europe;

- increased opportunities for cooperation in international nutrition studies within Europe arising from increased compatibility of the nutrient databanks;
- increased exchange of information on the development of nutrient databanks in Europe.

Eurofoods was established at about the same time as INFOODS was being formed. Eurofoods was closely associated with INFOODS and worked within its framework, but also worked independently.

In 1988, it was agreed to extend the work to food consumption and nutrient intake and following the successful submission of a European Commission proposal, the FLAIR Eurofoods-Enfant Concerted Action project, which ran from 1990-1994, was established. The objective of the project was to establish a comparable and compatible system of high quality data on food consumption and food composition.

Outputs from this project included:

- a handbook (in conjunction with INFOODS) on guidelines for the production, management and use of high quality data on food composition (Greenfield and Southgate, 1992);
- an inventory of nutritional software, to examine the breadth and scope of computer software being used in Europe at that time (Loughridge *et al*. 1993);

- an inventory of the availability of data in nutrient databases in Europe.

Food coding (classification) and food descriptions (names) were also addressed in the project. The Eurocode food coding system, used in some dietary studies, was revised, tested and evaluated. LanguaL was also examined to assess its usefulness in a European context.

COST Action 99

COST is an acronym for 'European cooperation in the field of scientific and technical research'. COST Action 99: "Research action on food consumption and composition data" began in January 1995, ended in 1999 and included participants from 25 European countries (COST Action 99 website: http://food.ethz.ch/cost99/main.htm), which was the largest participation at that time for a COST Action. It was a continuation of Eurofoods (established in 1982) and the FLAIR Eurofoods-Enfant project (1990-1994) and worked towards improving the quality and compatibility of data on food consumption and composition in COST countries.

The aims relevant to food composition were:

- to construct and establish a network of compatible food composition databases with the quality required for interpretation, description and exchange of high quality food consumption and food composition data;

- to continue to improve the quality and compatibility of data for inclusion in tables and databases of food composition;
- to maintain and improve existing food coding systems in order to exchange data efficiently.

Outputs from the COST Action 99 included:

- recommendations for food composition database management and data interchange (Schlotke *et al*. 2000);
- an inventory of European food composition databases and tables (Schlotke and Møller, 2000);
- publications relating to the food description system, LanguaL (Ireland and Møller, 2000; Møller and Ireland, 2000a,b,c).

EFCOSUM

The European Food Consumption Survey Method (EFCOSUM) project was undertaken within the framework of the EU programme on Health Monitoring between 1999 and 2001. A total of 23 European countries participated and the aim was to define a method for monitoring food consumption in nationally representative samples of all age-sex categories in Europe in a comparable way. One of the four topics covered was comparability of food composition tables (Ireland *et al*., 2002). The aim of this work topic was to harmonise food classification and food composition databases, allowing comparability of

consumption at both food and nutrient levels in Europe. It was concluded that the establishment of a European nutrient databank is a necessity for conversion of foods to nutrients (Brussard *et al*., 2002).

Where are we now?

The outputs from Cost Action 99 are being used in the initial documentation of national food composition datasets with limited funding and on an ad hoc basis. However, these recommendations need to be further tested and extended, to provide a basis for the comparison of data in the various European national datasets and their integration into a consistent, readily available information resource.

A number of underlying issues in the past have hindered the development of a single comprehensive food composition database for Europe. These include the lack of permanent structures to support those involved in developing and maintaining food composition databases, lack of national support, and the relatively poor links between the various national database compilers, end-users of the data (e.g. the food industry, public health nutritionists and European consumers), and policy makers.

EuroFIR

EuroFIR (European Food Information Resource Network of Excellence) aims to develop and integrate a comprehensive, coherent and validated databank providing a single, authoritative source of food composition data for Europe. As a Network of Excellence, EuroFIR aims to address the weaknesses that have hindered the development of such a database in the past, thereby accelerating the application of research results to policy and health developments, as well as developing partnerships with the private sector.

EuroFIR is a programme of work funded by the sixth framework programme, Food Quality and Safety Priority. This programme of work is an essential underpinning component of all food and health research in Europe.

The organisation of the network has been split into four 'platforms', including:

- Integration Activities
- Joint Research Activities
- Spreading of Excellence Activities
- Network management

Each 'platform' consists of between one to six work packages. Each work package will be managed by one or two organisations, although a number of partners may also be involved in the work package. Some partners will be working on more than one work package. This will promote continuous cross-communication between the work packages, which will be encouraged throughout the five year network.

Future developments

When Eurofoods was first established over 20 years ago, it was observed that "cooperation is necessary, because among other reasons, there is not enough money to meet all the wishes of those involved with food composition tables and nutrient databases" (Cramwinckel, 1985). This is more true than ever now and networks such as EuroFIR have an important role in supporting food composition databases and ensuring their future viability.

Food composition databases will inevitably expand, in terms of both foods and components. Availability of food composition data on the internet should increase considerably over the next few years. As data become more accessible to a wide range of users and as new components, such as bioactive compounds, are incorporated, the importance of thorough documentation (e.g. analytical methods) and harmonisation (e.g. food classification) will grow. Again, networks such as EuroFIR have a role in providing guidelines for and supporting national food composition database compilers.

Finally, quantitative data on the composition of foods are essential for most quantitative human nutrition research, and for the development of food and nutrition policies at the national and international level (Greenfield and Southgate, 2003). The importance of food composition research is not always recognised by funding bodies, but it is vital that food composition databases continue to be maintained and developed.

References

Atwater W.O. and Bryant A.P. (1906) The chemical composition of American food materials. *US Office of Experiment Stations, Experiment Stations Bulletin 28*. Washington: Government Printing Office.

Atwater W.O. and Woods C.D. (1896) The chemical composition of American food materials. *US Office of Experiment Stations, Experiment Stations Bulletin 28*. Washington: Government Printing Office.
http://www.nal.usda.gov/fnic/foodcomp/data/classics/index.html.

Brodarec A. (1976) Food composition table of food and drinks III edition. Croatia, Zagreb: PHI.

Brussard J.H., Löwik M.R.H., Steingrímsdóttir L., Møller A., Kearney J., De Henauw S. and Becker W. (2002) A European food consumption survey method – conclusions and recommendations. *European Journal of Clinical Nutrition* **56** (Supplement 2): S89 – S94.

CESNID (2003) Tablas de composición de alimentos del CESNID. Barcelona: CESNID.

Chatfield C. (1949) Food Composition Tables for international use. FAO Nutritional Study No 3. Washington DC: FAO UN. http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/x5557e/x5557e00.htm.

Chatfield C. (1954) *Food Composition Tables – Minerals and Vitamins – for International Use*. FAO Nutritional Studies No 11. Rome: FAO.

Charrondiere U.R., Vignat J., Møller A., Ireland J., Becker W., Church S., Farran A., Holden J., Klemm C., Linardou A., Mueller D., Salvini S., Serra-Majem L., Skeie G., van Staveren W., Unwin I., Westenbrink S., Slimani N. and Riboli E. (2002) The European Nutrient Database (ENDB) for nutritional epidemiology. *Journal of Food Composition and Analysis* **15**: 435-451.

Cramwinckel A.B. (1985) Purpose of nutrient databanks and options for Eurofoods. *Annals of Nutrition & Metabolism* **29**: (Supplement 1): 9-10.

Dam F. and Ege R. (1932) Vore vigtigste Fødemidlers Indhold af kaloriegivende Næringsstoffer og Vitaminer med forklarende Tekst. (Our most important food's content of energy-contributing nutrients and vitamins with explanatory texts.) Sorø: Svegårds Boghandel.

Day K.C. (1985) Nutrient databanks from the point of view of the computer programmer. *Annals of Nutrition & Metabolism* **29** (Supplement 1): 54-59.

Deharveng G., Charrondiere U.R., Slimani N., Southgate D.A.T. and Riboli E. (1999) Comparison of nutrients in the food composition tables available in the nine European countries participating in EPIC. *European Journal of Clinical Nutrition* **53**: 60-79.

Eekelen M. van, Janssen B.C.P. and Straub J. (1941) Voedingsmiddelentabel.

Food Standards Agency (2002) McCance and Widdowson's The composition of foods, 6th summary edition. (ed Roe M.A., Finglas P.M. & Church S.M.) Cambridge: Royal Society of Chemistry.

Gonçalves Ferreria F.A. and da Silva Graça M.E. (1961) Tabela da composição dos alimentos Portugueses. Lisbon: INSA.

Greenfield H. and Southgate D.A.T. (1992) Food composition data: production, management and use. London: Elsevier.

Greenfield H. and Southgate D.A.T. (2003) Food composition data: production, management and use, 2nd edition. Rome: FAO. http://www.fao.org/infoods/publications_en.stm

Groth-Petersen E. (1940) Grundlag for Beregning af de Menneskelige Fødemidlers kemiske Sammensætning. En Tabel. (Udgivet med støtte af Statens Husholdningsråd og Den almindelige Danske Lægeforenings Hygiejnekomite) (The Basis for Calculation of the Composition of Human Food's Chemical Composition.)

Helms P. (1978) Næringsstoftabeller (Nutrient Tables). Copenhagen: Lægeforeningens forlag.

Holland B., Welch A.A., Unwin I.D., Buss D.H., Paul A.A. & Southgate D.A.T. (1991) McCance and Widdowson's The composition of foods, 5th edition. Cambridge: Royal Society of Chemistry.

Ireland, J. and Møller A. (2000) Review of international food classification and description. *Journal of Food Composition and Analysis* **13**: 529-538.

Ireland, J., Van Erp-Baart A.M.J., Charrondière U.R., Møller A., Smithers G., and Trichopoulou A. (2002) Selection of food classification system and food composition database for future food consumption surveys. *European Journal of Clinical Nutrition* **56** (Supplement 2): S33 – S45.

Istituto della Nutrizione (1946) Tabelle di composizione in principii nutritive in calorie dei piu comuni alimenti. Rome: Istituto della Nutrizione.

Jürgensen C. (1888) Grafisk Fremstilling af de menneskelige Fødemidlers og nogle Spisers kemiske Sammensætning (Graphical Interpretation of Human Food's and some Composite Food's Chemical Composition). Schubothe.

Klensin J.C., Feskanich D., Lin V., Truswell A.S. and Southgate D.A.T. (1989) Identification of food components for data interchange. Tokyo: United Nations University. http://www.unu.edu/unupress/unupbooks/80734e/80734E00.htm.

Konig J. (1878) Chemie der menschlichen nahrungs- und Genussmittel. Berlin: Springer.

Kunachowicz H., Nadolna I. Krystyna I. Beata P (2005) *Wartość odżywcza wybranych produktów spożywczych i typowych potraw. (Nutritive Value of Selected Food Products and Typical Dishes*). Warsawa: Wydawnictwo Lekarskie PZWL.

Loughridge J.M., Walker A.D. and Towler G. (1993) Inventory of nutritional software. FLAIR Concerted Action Programme No. 12: Eurofood-Enfant Project.

McCance R.A. & Lawrence R.D. (1929) The carbohydrate content of foods. Medical Research Council Special Report Series No. 135. London: His Majesty's Stationery Office.

McCance R.A. & Shipp H.L. (1933) The chemistry of flesh foods and their losses on cooking. Medical Research Council Special Report Series No. 187. London: His Majesty's Stationery Office.

McCance R.A., Widdowson E.M. & Shackleton L.R.B. (1936) The nutritive value of fruits, vegetables and nuts. Medical Research Council Special Report Series No. 213. London: His Majesty's Stationery Office.

McCance R.A. & Widdowson E.M. (1940) The chemical composition of foods. Medical Research Council Special Report Series No. 235. London: His Majesty's Stationery Office.

McCance R.A. & Widdowson E.M. (1946) The chemical composition of foods. Medical Research Council Special Report Series No. 235, 2nd edition. London: His Majesty's Stationery Office.

McCance R.A. & Widdowson E.M. (1960) The composition of foods, 3rd edition. Medical Research Council Special Report Series No. 297. London: Her Majesty's Stationery Office.

Møller A. (1983) Levnedsmiddeltabeller. Copenhagen: Dafolo Forlag.

Møller A. and Ireland J. (eds) (2000a) LanguaL 2000 – The LanguaL thesaurus. *Food Sciences and Technology. COST Action 99.* Luxembourg: European Communities, EUR 19540.

Møller A. and Ireland J. (eds) (2000b) LanguaL 2000 – Documentation of changes from Version 0. *Food Sciences and Technology. COST Action 99.* Luxembourg: European Communities, EUR 19541.

Møller A. and Ireland J. (eds) (2000c) LanguaL 2000. Introduction to the LanguaL thesaurus. *Food Sciences and Technology. COST Action 99*. Luxembourg: European Communities, EUR 19542.

Moreiras O., Carbajal A and Cabrera L. (1992) La composición de los alimentos: contenido en energia, macronutrientes, minerales, vitamines, ácidos grasos y colesterol. Madrid: EUDEMA.

Nutrition Council (1960) Food composition table. Oslo, Norway: The National Association for Nutrition and Health. (Statens ernaeringsrad (1960) Naeringsmiddeltabell. Oslo: Landsforeningen for kosthold og helse.)

Nubel (1992) Belgische voedingsmiddelentabel, book, ISBN 90-74362-02-8; Table belge de composition des aliments, ISBN 90-74362-01-X.

Nubel (1995) Nubel – voedingsplanner floppy disk, ISBN 90-75448-01-5; Planning Alimentaire Nubel floppy disk, ISBN 90-75448-01-5

Nubel (1999) Nubel – voedingsplanner CD-ROM, ISBN 90-75448-03-1; Planning Alimentaire Nubel CD-ROM, ISBN 90-75448-03-1.

Nubel (2004) Belgische voedingsmiddelentabel, book, ISBN 90-74362-07-9; Table belge de composition des aliments, book, ISBN 90-74362-08-7.

Paul A.A. & Southgate D.A.T. (1978) McCance and Widdowson's The composition of foods, 4th edition. London: Her Majesty's Stationery Office.

Percy P.F. & Vaquelin N.L. (1818) Sur la qualitié nutritive des aliments comparé entre eux. *Bulletin of the Faculty of Medicine, Paris* **6**: 75-91.

Plimmer R.H.A. (1921) Analyses and energy values of foods. London: His Majesty's Stationery Office.

Rand W.M., Windham C.T., Wyse B.W. and Young V.R. (1987) Food composition data: a user's perspective. Tokyo: United Nations University. http://www.unu.edu/unupress/unupbooks/80633e/80633E00.htm.

Randoin L., Le Gallic P., Dupuis Y., Bernardin A., Duchène D. and Brun P. (1961) Tables de composition des aliments, 3rd edition. Paris: Institut Scientifique d'Hygiène Alimentaire, Centre National de la Recherche Scientifique.

Rudowska-Koprowska J. (1954) Tablice wartosci odzywczych produktow spozyczych. Warsaw: Panstwowy Zakad Wydawnictw Lekarskich.

Schlotke F., Becker W., Ireland J., Møller A., Ovaskainen M.L., Monspart J. and Unwin I. (eds) (2000) Eurofoods recommendations for food composition and data interchange. *Food Sciences and Technology. COST Action 99.* Luxembourg: European Communities, EUR 19538.

Schlotke F. and Møller A. (eds) (2000) Inventory of European food composition databases and tables. *Food Sciences and Technology. COST Action 99.* Luxembourg: European Communities, EUR 19539.

Society for Nutrition (1992) Food composition table, part 1. Czech Ministry of Agriculture.

Somogyi J.C. (1974) National food composition tables, in Southgate D.A.T. Guidelines for the preparation of tables of food composition, pp1-5. Basel: Karger.

Southgate D.A.T. (1993) The composition of foods, in Ashwell M. (ed) McCance & Widdowson A scientific partnership of 60 years, pp 69-77. London: British Nutrition Foundation.

Statens Livsmedelsverk (1981) Livsmedelstabeller: energi och vissa näringsämnen. (Food composition tables: energy and certain nutrients.) Uppsala: Swedish National Food Administration.

Trichopoulou A. (1982) Food composition tables. Athens: Lenis.

Truswell A.S., Bateson D.J., Madafiglio K.C., Pennington J.A.T., Rand W.M. and Klensin J.C. (1991) INFOODS guidelines for describing foods: a systematic approach to describing foods to facilitate international exchange of food composition data. *Journal of Food Composition and Analysis* **4**: 18-38. http://www.fao.org/wairdocs/AD069E/AD069E00.HTM

Úlehlová-Tilschová M. (1947) Vís co jís (You know what you eat). First Czechoslovak Tables on Food Composition. Prague.

West C.E. (ed) (1985) Eurofoods: towards compatibility of nutrient databanks in Europe. *Annals of Nutrition & Metabolism* **29** (Supplement 1): 1-72.

Widdowson E.M. (1967) Development of British Food Composition Tables. *Journal of the American Dietetic Association* **50**: 363-367.

Widdowson E.M. (1974) A brief history of British food composition tables, in Southgate D.A.T. Guidelines for the preparation of tables of food composition, pp 53-57. Basel: Karger.

Yiannopoulos S., Frenaritou H., Kokkinofta R., Argyrides R. and Akkelidou D. (1999) Cyprus food composition tables. Nicosia: Ministry of Health State General Laboratory.