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An overview of the influential developments and stakeholders within the food composition program of Australia

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Abstract
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An overview of the influential developments and stakeholders within the food composition program of Australia

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ABSTRACT:

Development of the Australian food composition program, focussing on the enablers and barriers to progress, is reviewed following a process of reference harvesting and unstructured interviews with experts. Strong growth in new data and publications during the 1930s and 1970/80s was followed by more stagnant periods, particularly during the 1990s, enabled by data needs for national nutrition surveys, labelling requirements and national policy needs. From the late 1980s there was a move from paper to computerised tables and then to online databases in the 2000s. Australia's food composition tables have evolved in line with international developments in science and changed data publication methods. Maintaining the timeliness of these databases requires significant investment in new analytical data and skilled scientists to drive this process.

Keywords: Food composition, Australia, history, food science

INTRODUCTION AND METHODS:

Food composition, the science behind differentiation of the complex food matrix, has slowly gained recognition globally despite early challenges. Collation of comprehensive data sets has many considerations layered upon it inherent to its objective. Food composition must deal with factors of geography, geology, horticulture, physiology, analytical chemistry and information technology at one end of the spectrum, namely data production, and at the other end, with diverse data uses, including for epidemiology, psychology, gastroenterology, dietetics, food science, public health and even informatics. The methods of development and use of food composition tables have changed, with recent worldwide efforts toward standardisation of practice. Food composition, due to its multidisciplinary nature, has not always been recognised as a credible science with the interaction of external influences such as government and, in turn, public health policy, either growing or hindering its progress.

Globally, it appears that the early efforts towards the development of composition data began with Johann Friedrich John's 1814 compilation of 700+ plant analyses (Colombani, 2011), although a major impetus for development of Australian databases was likely the work of Atwater and the release of the Atwater factors in 1896 (S. Church, 2006). Extensive reviews of the history of food composition programs of the United States of America and of Europe have been conducted noting nutrition scales as early developments in this field (S. Church, 2006). Colombani meanwhile outlines the developments with the beginning of food composition with the progress of the chemical composition of bodies, namely the three to five element systems which largely took shape during the 1700s and considers the format of the table to impact on what could be considered a true food composition data table. Despite this, the first known tabulated data of food composition appears to have stemmed from work published in Germany. Originally this work was dated 1878 (S. Church, 2006) shortly before Atwater's impact on the American program (Colombani, 2011) however, Colombani in his 2011 review later outlined his justification for 1818 tables produced by Percy and Vauquelin to be considered one of the oldest single nutrient food composition tables at the time of publication demonstrating that food composition as a field could be dated to be over 230 years old.

Shifting from this very early progress, another interesting development occurred many decades later in October 1949 when the Food and Agriculture Organization published Food Composition Tables for International Use (http://www.fao.org/docrep/x5557e/x5557e00.htm), aiming to assist with the food availability on a global level (S. Church, 2006). A second edition published in January 1953, these tables used data from 151 food composition reports globally documenting values for 66 foods across most continents including 2 reports from the Oceania region. Values were primarily

presented as averages of the source data with the Oceania data contained in this report stemming from the 1946 Australian data produced by Anita Osmond as addressed later in this review.

Despite these early attempts to globalise food composition tables, it was determined that regionally specific tables were needed. Australia has a very unique food environment with many indigenous foods and a large food export sector due to its geographic location. Resultantly, the progress of food composition activities is quite different to other countries such as the US or the UK and warrants exploration. The aim of this review, therefore, is to document the development of the food composition program in Australia with particular focus on the enablers and barriers to its progress.

Given the diversity of the Australian program, a multi-method approach was employed including a process of reference harvesting to obtain published reports and tables of food composition for Australia, contacting professional bodies to obtain minutes of their meetings which may have related to food composition and consultation with published experts of food composition. This approach was felt to address the primary basis of historical data documentation with published documents often cross referenced in either the meeting minutes or the expert interviews improving the validity of the findings. Furthermore, this approach allowed verification of name changes to departments and organisations involved in the program over the past decades. Details are outlined below for the specific methods applied in each component.

1. **Reference harvesting-** Initially drawing on published Australian food composition data tables, preferably original prints, obtained from Australian University library databases, the National Library of Australia and Food and Agriculture Organization (FAO) archives (online) library databases. The number of foods and nutrients contained in the tables as well as updates of parallel analytical progress was noted. Published proceedings of OCEANIAFOODS conferences were obtained. A keyword search of an archival database of Australian dietetics was conducted by a third party using [keywords] (food analysis nutrient tables, food science, food chemistry, ready reckoner, nutritional values, Australian Nutrient Data Bank, NUTTAB, AUSNUT, CoFA (Composition of Foods Australia), INFOODS, FAO) AND [organisations] (ANZFA/FSANZ, Commonwealth Department of Health, Department of Community Services and Health, National Health and Medical Research Council, The Australian Institute of Anatomy, Australian Government Publishing Service, Crop and Food, OCEANIAFOODS, Australian Government Analytical Laboratories, University of New South Wales, National Food Authority) with a date limit of 1938-2013 (Wood, 2012).

   Food composition tables for 1938, 1939, 1941, 1944, 1946, 1954, 1961, 1970, 1977, 1989 and 1991 and their reprints (as needed) were obtained (Figure 1), analysed and their

reference lists drawn on. 86 archival documents were obtained from the Australian dietetic database and cross referenced against those already obtained. Outstanding references were sourced from National Archives of Australia.

2. **Professional bodies-** Key organisations involved in food composition, namely Food Standards Australia New Zealand (FSANZ, formerly Australia New Zealand Food Authority, and National Food Authority), National Health and Medical Research Council (NHMRC), Department of Health (DoH) (formerly Commonwealth Department of Health, CDoH) and the FAO's INFOODS program were contacted requesting archival documentation related to food composition. The Nutrition Society of Australia (NSA) and Dietitians Association of Australia (DAA), professional associations for nutrition, were also contacted requesting minutes of milestone meetings.

   DAA meeting minutes of 1950-1983 were obtained from the Australian National University Noel Butlin Archives, while NSA referred the inquiry back to Heather Greenfield, Fellow of the Society and primary advisor for this manuscript. Meeting minutes of the Nutrition Standing Committee of NHMRC from 1974-1990 were obtained and online archival records from FSANZ (http://archive.foodstandards.gov.au) were keyword searched as per (1). The DoH also referred the inquiry to FSANZ. OCEANIAFOODS conference proceedings for 1987-2005 were obtained and country reports extracted.

3. **Expert consultation-** Academics, researchers and authors/editors named in any of the above documentation were contacted for conduct of unstructured telephone interviews. Experts were asked to talk about their involvement in food composition in Australia and their related career. Regional OCEANIAFOODS coordinators were also consulted to create a history of the program. This study was approved by the Human Research Ethics Committee of the University of Wollongong. All interviewed participants provided verbal informed consent prior to participation.

   Expert consultations were conducted with Janis Baines, Jennie Brand-Miller, Barbara Burlingame, Annette Byron, Sue Cassidy, Judy Cunningham (co-author), Ruth English, Heather Greenfield, Janine Lewis, David Mugford, Catherine Saxelby, Anne Schneider, Stewart Truswell, Renee Sobolewski and Ron Wills. Detail about key players such as Karen Cashel, Margaret Corden and Sucy Thomas were obtained from others during the interviews.

KEY DRIVERS OF THE AUSTRALIAN PROGRAM:

Data is presented based on influential domestic and international drivers of the program, analytical progress and progress of the food composition tables and databases, in chronological order.

Drivers for the development and expansion of Australia's food composition efforts include both domestic and international developments.

The need for nutrient data to support national health and nutrition policy and accurate food labelling was recognised by Australian government bodies from the 1930s onwards. The 1930s saw the first nutrient data generated for Australian foods, and the first set of compiled nutrient data for Australia, to support national nutrition surveys being conducted at that time.

In the 1940s, new nutrient data was generated to support Australian defence efforts. Hedley Marston and Mary Dawbarn of the Animal Nutrition Laboratory of Commonwealth Scientific and Industrial Research Organisation (CSIRO) compiled nutrient data in 1944, during World War 2, to support the requirements of the Department of the Army (Marston & Dawbarn, 1944). The Defence Department has also supported more recent analysis of indigenous ('bush') foods (BA Burlingame, Monro, & eds, 1993).

National science and dietetic associations provided impetus and support for food composition activities from around the 1950s onwards. These associations included the DAA and its forerunner State-based organisations, and the NSA. The Australian Institute of Food Science & Technology (AIFST) supported the publication of an extensive series of publications based on original nutrient analyses, conducted largely at the University of New South Wales (UNSW). These publications created exposure to the food industry and encouraged food composition to be seen as a research topic due to the careful approaches to sampling and data scrutiny ("line by line") undertaken by the researchers (Wills and Greenfield).

The Australian food industry also recognised the importance of nutrient data for its products. The firstly involvement of food industry in the analytical work for Australia was likely with the development of the Bread Research Institute (BRI, CSIRO) in 1947. The BRI employed analyst David Mugford in 1970 to perform analytical work, primarily bread related.

Consideration of the need for food fortification has also driven government demand for food composition data. In the 1970s, NHMRC sought nutrient data for wheat, flour and their related products, primarily due to their consideration of the need for thiamin fortification; during 1977 and

1979 all Australian flour mills were surveyed to discover that thiamin levels had increased due to improvements in flour mill efficiency and changes in wheat varieties (Mugford, Stenvert, & Venn Brown, 1979). Similarly, there were also changes to levels of some minerals in the flours. The surveys were repeated during 1982-3 and 1990s with assistance from the CSIRO, Australian Government Analytical Laboratory (AGAL), UNSW and Deakin University (Mugford, Griffiths, & Walker, 1986). More recently, there have been surveys of the levels of folic acid in bread following the introduction of mandatory folic acid fortification of bread-making flour (Dugbaza & Cunningham, 2012).

The introduction of a range of food labelling requirements from the 1980s has also driven food composition in Australia. This has included simple analyses such as the mass of slices of bread, through to analysis of individual nutrients (Mugford, 1993). Ruth English similarly described the impact of nutrition information on food labels as an important shift for food composition.

By the 1980s, fast food chains such as McDonald's, Kentucky Fried Chicken (KFC) and Pizza Hut operated across the country and a focus on different 'ethnic' foods also grew as Australia's population diversified (Greenfield, Lerogiannis, Makinson, & Wills, 1983; Wills, Maples, & Greenfield, 1981). McDonald's provided grant funding to analyse their foods and publish the data The foods at the time were found to be low in fibre and Vitamin C (Wills & Greenfield, 1981). Changes to their advertising campaigns resulted, with advertisements portraying farm cattle, peas and potatoes as imagery. During this time, Pizza Hut also sponsored the analysis of pizzas and KFC of their products (Greenfield, Wimalasiri, Ma, & Wills, 1982; R.B.H. Wills & H Greenfield, 1982). Snack foods at the time were analysed for Associated Products and Distribution Pty Ltd (APD) snacks, now Smiths Snackfoods, another sponsor, and a substantial amount of lactose was found in their crisps (R.B.H. Wills & H. Greenfield, 1982). The company found its suppliers were using lactose as a filler and the product formulation was changed.

Dietitians Annette Byron and Anne Schneider described early work by a group of South Australian (SA) dietitians to collate manufacturer-based food information during the late 1980s. The work primarily focussed on the inclusion of food 'free from' various allergens. Information was collated on a floppy disk with 1-2 volumes of information generated. This project received national DAA funding though, due to its resource-heavy nature and "questionable reliability" due to reliance on the postal service, was discontinued. This showed early dietetic interests in such data.

Industry support grew as new food composition tables were released. In NUTTAB92 (Nutrient Data Table for use in Australia) data was provided by the edible fats and oils, brewing and wine industries, the Canned Food Information Service and the (then) Australian Meat and Livestock Corporation. The

Australian meat industry has been a major industry supporter of national food composition data. For example, in the 2000s, Meat & Livestock Australia (covering ruminant meats), Australian Pork Limited and Chicken Meat Federation have funded extensive analytical and gross composition data on meats (Probst, 2009; Sinclair et al., 2010; Williams, 2007). More recently, the method for Vitamin D analysis in Australia was developed as a component of a meat industry funding grant received by David Fraser and Heather Greenfield (Liu et al., 2008). A full time senior analyst (Norbert Strobel) at the National Measurement Institute (NMI) was assigned to this task.

The primary influence of the British food composition program on the Australian data stems from the early UK tables (Widdowson & McCance, 1935). Over a number of releases of Australian tables, data gaps were filled using British food composition data. For example, the first release of NUTTAB in 1987—88 contained about 50% of the data from overseas sources, but by 1991 had declined to around 10%. In NUTTAB92, British data were used for fatty acid groups (total saturated fat, monounsaturated fat and polyunsaturated fats) and dietary fibre. In the AUSNUT (Australian Food and Nutrient Database) database used with the 1995 National Nutrition Survey to estimate Australian folates intake, around 80% of the folates data were borrowed directly, or imputed from UK data.

The developments in Australia paralleled developments in the USA, where nutritional epidemiologists recognised the inadequacies in the American food tables in coverage of both nutrients and foods. Nevin Scrimshaw (1918-2013), Vernon Young (1937-2004) and others began a worldwide campaign for improved food composition data. A 1983 meeting in Bellagio, Italy, sponsored by the Food, Nutrition and Poverty Sub-programme of the United Nations University and supported by varied US government agencies, private organisations, and food industry, resulted in the establishment of the INFOODS program in 1984 (W. Rand & Young, 1984). Among several recommendations arising from that meeting, was one for a comprehensive textbook on “how to do the work” within food composition (W. M. Rand & Young, 1983). Heather Greenfield of Australia with David Southgate under the auspices of INFOODS produced the first edition of the world renowned ‘Greengate’ book in 1992. This book was also used to develop intensive training courses for food composition, initially in 1992 in Wageningen, the Netherlands, run by Australian born Clive West. INFOODS moved to FAO in 1999 and updated the book to its present online and 2nd edition in 2003, with the training courses spreading worldwide (Greenfield & Southgate, 2003). The first Australian course was held in 2009 at UNSW (Probst, 2010).

OCEANIAFOODS was established in 1987 to bring together food composition experts of the Asia Pacific region and forms part of FAO’s INFOODS network. Under the stewardship of Ruth English, it

was felt an international approach needed to be brought to the methodology for recording food composition information. This approach was later adopted by FAO. Led by Barbara Burlingame, who was then based in New Zealand, and others (including Bill Aalbersberg of Fiji and Ruth English of Australia), OCEANIAFOODS held regular conferences, the first in 1987 (Canberra, Australia) , followed by 1989 (Suva, Fiji), 1991 (Auckland, New Zealand), 1995 (Suva, Fiji), 1998 (Noumea, New Caledonia), 2002 (Brisbane, Australia), 2005 (Wellington, New Zealand) and most recently in Sydney, Australia, in 2009 (Aalbersberg & ed, 1996; BA Burlingame et al., 1993; English, Lester, & eds, 1987; Food Standards Australia New Zealand, 2002; Greenfield, Athar, Murphy, & eds, 2005; Health, 1991; The University of the South Pacific & The Secretariat for the Pacific Community, 1998). In recent years, OCEANIAFOODS has struggled for relevance, as only two member countries (Australia and New Zealand) have active food composition programs, reflecting a lack of food composition funding for the Pacific region.

Development of the analytical program – post 1960-

After early activity in the 1930s, further comprehensive analytical projects resumed in the 1970s. The initial Greenfield and Wills NHMRC grant proposal in 1977 included direct HPLC analysis of individual sugars, and starch after conversion to glucose, instead of "carbohydrate by difference", analysis of a range of minerals by atomic absorption spectroscopy, and of fatty acids by gas chromatography (English, 1981). Analysis of cholesterol was also included. The UNSW team quickly found that analytical methods for the ambitious program first had to be validated and established. Another problem was a suitable mechanism for publication since composite rather than individual samples were analysed, and such studies would not be eligible for publication in most international scientific journals. In the 1980s NHMRC also funded studies on the effects of processing and preparation practices on nutrient composition, and on the nutrient composition of beef and lamb.

The 1980s saw a large government investment in nutrient analyses, in preparation for the release of new food composition tables. Foods for analysis were separated into major food groups and for each group, specific foods were selected for analysis. Preference was given to analysis of those nutrients shown to have public health and clinical applications in the community. Consideration was also given to the current status and reliability of the available methods and the laboratory facilities and resources available. Selections were also based on nutrients published in UK and US tables.

It was during this time that Stewart Truswell, working with Jennie Brand Miller and Vic Cherikoff, an analytical chemist, discovered the very high vitamin C content of the *Terminalia ferdinandiana,* Kakadu plum (Brand, Cherikoff, Lee, & Truswell, 1982). During the early 1990s Australian Research

Council funding was obtained to collate bush food data from the various regions of Australia. Selections of bush foods were analysed, as eaten, by the University of Sydney. The preparation of the foods was vital given some foods such as Cheeky Yams (*Amorphophallus galbra*) are toxic if not prepared properly while others needed to be ground and left in a dilly bag (bag of woven fibres) in a running stream for up to a week. Foods collected included mangrove worms, crickets, grasshoppers, snakes, turkey eggs and fruit that had been vine dried throughout the year. The foods analysed were obtained from across Australia but were primarily from the Northern Territory (Brand-Miller, 2013).

An excess supply of some foods was noted (Brand et al., 1983). At the time it had also been postulated that traditional foods may inherently be lower in Glycaemic index (GI) resulting in the low rates of diabetes of indigenous groups with traditional lifestyles (Jenkins et al., 1987). This saw Brand Miller create her first honours project for a student addressing the GI of bush foods. This work has led to many developments including an online database of GI (http://www.glycemicindex.com/) and Glycaemic load from all sources around the world.

Later, it was also discovered that others in Tasmania (Keith James *et al*) and Western Australia (Pat Margorie *et al*) were also analysing bush foods. Collaboration saw the work collated and published by the Aboriginal Studies Institute in 1993 with single food categories published in Food Australia (Brand Miller, Maggiore, & James, 1993). Unfortunately this data only covered proximates and some other factors (Thiamin, Riboflavin, Vitamin C, Na, K, Mg, Ca, Fe, Zn, Cu, Pb, Cd, P), as it was essentially seen as a preliminary investigation, although to date only limited subsequent research on bush foods has taken place.

Analytical advances for vitamins also occurred in Australia with the work of Jayashree Arcot of UNSW in folates and Greenfield and colleagues advancing the analysis method for vitamin D in a meat based matrix, as noted earlier (Iwatani, Arcot, & Shrestha, 2003; Liu et al., 2008).

DEVELOPMENT OF FOOD COMPOSITION TABLES AND DATABASES:

Progress of printed tables (1938-1990)-

The first documented food composition tables for Australia were published in 1938 (Commonwealth of Australia, 1938), an outcome of an Advisory Council meeting on Nutrition led by J.H.L. Cumpston, at the School of Public Health and Tropical Medicine in Sydney. The data was obtained from the analysis, by biochemist Dr Geoffrey Bourne, of commonly eaten foods reported in family dietary surveys (English, 1981). Dr Bourne's data forms Appendix 1 of the 5th report of the council. The data was collated as a food list from analysis of foods for New South Wales (NSW), Queensland (QLD) and

Victoria (VIC) with the later addition of foods from SA by a social worker (Miss Glasson). In total 1172 food items, spanning 17 food groups, from 3222 food record books were contained in the food lists included in the report (reproduced as Table 1). The report addresses the need to use data provided by Atwater and colleagues in the US, UK and Europe to determine energy content (Atwater & Bryant, 1906). It was noted (probably incorrectly) that the composition of meat, fruit and vegetable was unlikely to vary considerably between Australia and other countries. Variation of cakes and biscuits was seen as a concern due to differences in icing, amount of cream and weight of the product. Sampling included weekly (ideally) samples of foods over a period of one year, though due to the urgency of the data, a number of samples of the foods were taken wherever possible. Data for protein, fat and carbohydrate were compared with existing data for other countries, seeing differences primarily in fat and protein content. Total calories for 178 commonly consumed foods was also recorded based on usual serving size, an economic index created showing the number of grams of protein, fat and carbohydrate per penny, and a score for 214 food items to be used at times of national emergency. Alongside this, a wastage survey of a university college was conducted and selected foods from QLD analysed for 8 minerals by Professor DHK Lee. The Council noted a recommendation of a central coordinating committee be developed with the aim to address *"a) the general health of the rising generation; b) the correction of faulty dietary [information] in a general sense by the publication of sound propaganda and dietary advice from time to time; c) the investigation and rectification of specialized local defects, both physical and nutritional, by coordinated effort."* (Fifth report of the Advisory Council on Nutrition, p2). Pamphlet number 1 about food composition followed shortly after in 1939 (Institute of Anatomy, 1939).

Hedley Marston and Mary Dawbarn of the Animal Nutrition Laboratory of CSIRO (Marston & Dawbarn, 1944) compiled tables in 1944 based on data created as requirements of the Department of the Army. This original data was hurriedly collated without reference to data sources. November 1943 saw sign off on an updated data set with a meat product focus, published in 1944, which referred to McCance and Widdowson as a primary data source with the data for beef obtained from the USA, pork from both USA and UK data and analytical data for mutton.

The NHMRC Special report series number 2 formed the 1946 composition tables. The tables were revised in 1948 due to new data becoming available and the request of the Australian Dietetics Council (ADC) of NSW and VIC for three new sections. The publication was divided into values per 100g portions of selected foods in their uncooked edible form, 1 ounce portions in their uncooked edible form, 1 ounce portions as purchased, vitamin C content of fruits and vegetables in descending

order, available carbohydrate content of selected foods and a ready reckoner for rapid calculation of hospital diets (Osmond, 1946).

Reprints saw the tables reappear in 1950. Dietitians in 1951 were encouraged to use these tables for nutrition research and to disseminate any food analysis information they had available to them (Richardson). During this time Joan Woodhill appears to have collated food tables in 1952 with a significant revision of tables prepared by dietitians Anita Osmond and Winifred Wilson in 1954 (Wilson, 1957). ADC further encouraged dietitians to use the new tables in 1955 with additional sodium values available in 1956 from the Institute of Anatomy. 1957 then saw the development of 'Simplified Food Composition Tables: Composition of selected foods, raw, processed and cooked, expressed in common household portions' containing lists of food sources of the included nutrients upon the advice of the ADC (Richardson). These tables also noted data being compiled from the 1952 and 1938 tables in "Australian measures". Two further reprints of the 1954 tables were released in 1961 and 1964. The 1954 update included revisions to the values for water, protein, fat and carbohydrate content of flour, bread and preserved milks. The values for milk were better aligned with the food regulations of the time and values for meat revised based on new research. There were previously no reliable values for different meat cuts or cooking methods. The vitamin C content (as ascorbic acid only of common portion sizes of fruits and vegetables was added, as was the composition of some beverages (Cashel & Greenfield, 1996). Recommended dietary allowances were included and the ready reckoner was enlarged and revised (Osmond, 1954). These dietary allowances were one of the sections adjusted by N.E. Kirk in the 1961 version alongside a statement about calculation of vitamin A activity, previously referred to as the vitamin A value of a food. By this time, the tables continued to include both the per 100g edible values as well as those per ounce edible (Osmond & Wilson, 1966).

Developments during the 1970s saw Sucy Thomas and Margaret Corden revise Anita Osmond's nutrient tables of 1946 (Thomas & Corden, 1977a). Revision was based mainly on data derived from USA tables, primarily Church and Church (1963) and Watt et al. (1963), British tables and German tables (C. Church & Church, 1963; McCance & Widdowson, 1960; Souci, Fachmann, & Kraut, 1974; Watt & Merrill, 1963), with some local data. Even though it was suggested at the 1968 Royal Society of Conference Editors that the unit Joule be used for all forms of energy, the following Australian food composition tables, namely 1970, still retained use of kilocalorie with a conversion factor for kilo- and megajoule provided (Food and Agriculture Organization, 2013). Similarly, available carbohydrate was also still being used alongside carbohydrate by difference, first reported in Australia by Geoffrey Bourne (Commonwealth of Australia, 1938). The terminology for some

nutrients was also revised from 1954 with carotene and vitamin A together being referred to as beta-carotene equivalents and Retinol expressed in micrograms in the 1970 edition of the tables (Food and Agriculture Organization, 2013;). The tables were available as per 100g and per average serving measures despite a push from ADC that household measures were useful for teaching purposes (Richardson). These tables were reprinted in 1977 with the per 100g tables removed (Thomas & Corden, 1977b).

First published in 1989, Composition of Foods Australia (CoFA) was a collation of existing analytical programs and began the development of a seven volume library of food composition data (Cashel, English, & Lewis, 1989). Foods were grouped based on the tables of previous years. Mixed dishes were categorised by the proportion of ingredients, seeing meat pies, for example, in the cereals group. Volume 1, the largest, included data for meats, fruit, vegetables, snack foods, major take away foods and for other foods from the former metric tables. Volume 2 (1990) included cereal and cereal products; volume 3 dairy products, eggs and fish; volume 4 fats and oils, processed meat, fruit and vegetables; volume 5 nuts and legumes, beverages and miscellaneous foods; volume 6 (1992) infant foods and volume 7 (1995) ethnic foods.

Two summary documents of CoFA were produced in 1991. A non-descriptive subset of foods (n=1600) by December 1991 forming the Nutrient values of Australian foods, with values provided per 100 g. A similar summary document, Food for health: A guide to good nutrition, was also published using per serve nutrient values (English & Lewis, 1991). The festive time of the publication can be noted by the inclusion of the caloric value of festive foods as requested by Ruth English. Updates were made to CoFA as required until 1995, at which stage up to 134 nutrients had been included with a push to include nutrients of emerging public health concern e.g. fatty acids and folate. In later publications, growing interest in folate nutrition and fortification created the need for improved Australian folates data, generated using the triple-enzyme microbiological method of analysis. The fatty acid databases were developed separately, though in the past decade have been incorporated into the main databases (Ollis, Meyer, & Howe, 1999).

The era of computers – moving to electronic databases (1987-present day)-

In 1987 the first electronic database, NUTTAB, was released. It was based on dietary survey databases compiled for analysing food intake data from the 1983 and 1985 Australian dietary surveys. The data set used a combination of Australian analyses and data from British tables (Paul & Southgate, 1978).

By the 1990s, requests for electronic versions of the tables were increasing. An improved data management system was developed at the then Australia New Zealand Food Authority (now Food Standards Australia New Zealand, FSANZ), which began compiling the food composition tables at around that time. During 1994-96, the Australian Nutrient Data Bank (ANDB), a PC software solution was custom built by a private company (Millpost) and updated as needed; it was still in use in 2014.

The 1995 NUTTAB contained 1800 records; approximately 1700 were Australian data and the remainder borrowed (British) data. In 1999 two databases, the Supplement to NUTTAB95 and AUSNUT, were released. The Supplement to NUTTAB95 comprised eight data files containing updated information for fatty acids, amino acids, carbohydrate components and organic acids. AUSNUT contained a complete collection of nutrient data for all foods reported in the 1995 National Nutrition Survey (NNS) (B Burlingame, Lewis, Aalbersberg, & Matenga-Smith, 1996). Unlike NUTTAB 1995, which primarily contained analysed data, AUSNUT also contained data derived from calculations and borrowed from overseas databases. Missing nutrient values, including folates, were filled using professional judgment as to the suitability of either USA or UK data, depending on the food item. After the release of the results of the 1995 National Nutrition Survey, the folates values were updated to take account of the addition of folic acid to fortified foods such as breakfast cereals. AUSNUT 1999 was the first data release on CD-ROM. It contained seven inter-related data files and explanatory notes containing descriptive and numerical data.

These two databases (NUTTAB 1995 and its 1999 Supplement, and AUSNUT 1999) remained the main two Australian databases until the release of NUTTAB 2006 in early 2007, largely led by Judy Cunningham. A subsequent AUSNUT 2007 was released in 2008 stemming from the Children's Nutrition and Physical Activity Survey in 2007, and another in 2014, prepared for the 2011-12 Australian Health Survey.

Moving online-

In November 2001 ANZFA released a web-based, online nutrition labelling tool, the Nutrition Panel Calculator (NPC) (Cunningham & Trevisan, 2002) to assist food manufacturers calculate the average nutrient content of their products and prepare nutrition information panels as required by Australian regulations. NPC drew on a revised version of the AUSNUT database, AUSNUT Special Edition (Australian Food and Nutrient Database for Nutrition Labelling), with extensive revisions specific for labelling purposes. Release 2 of AUSNUT Special Edition, incorporating minor data revisions, was published in May 2002; Release 3, in January 2004; with another release in 2011 with an updated user interface.

NUTTAB 2006, the first collation of primarily analytical data for around 10 years, was the first time Australia's database was released online allowing interrogation of data or print of PDF data that mimicked the layout of past printed tables. The long time between NUTTAB95 and NUTTAB06 was concerning for data users and highlighted the need for resources for data generation and compilation to be available for this purpose. Another edition (NUTTAB 2010) was released in 2011, with improved functionality and without the PDF option. NUTTAB 2010 included the results of FSANZ developmental work with a key foods program, based on that used by the USDA, in which foods were prioritised for analysis by nutrients of interest. This process found only 40-50 foods contribute 80% of intake of the key nutrients. AUSNUT 2007 was also available online as downloadable Microsoft Excel spreadsheets. The 2007 version of AUSNUT contains data for 4227 foods, beverages and dietary supplements and nutrient data for 37 nutrients (Food Standards Australia New Zealand, 2010). The 2010 version of NUTTAB contains 2668 foods and up to 245 nutrients (Food Standards Australia New Zealand, 2013). A complete summary of foods and nutrients contain in the Australian tables can be seen in Table 2.

CONCLUSION- FUTURE CHALLENGES:

In Australia, food composition remains a growing science that has evolved amidst varying drivers, competing needs and fluctuating resources. Food composition data is now incorporated into software packages to support data users. Use of these packages was, and is still, often taught incorrectly, but software developers have, however, managed to re-engage users in food composition.

The food industry needs to continue to produce analytical data for Australian foods and to submit their data for inclusion in Australian databases to allow users of the data to have more accurate nutrient values. There is also a need for researchers and clinicians in the field to work together to support the creation of accurate and up to date food composition data for Australia. Without such collaboration, Australia may again see a stagnant dataset as was found during the latter period of the last century.

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