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Uses and abuses of food composition data

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Proceedings of a Symposium held at the University of New South Wales, 25 and 26 September, 1989, organised by the Dietitians' Association of Australia (NSW), the Council of Australian Food Technology Associations and the Department of Food Science and Technology, UNSW.

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Copies of these proceedings are available from A/Prof. H. Greenfield, Department of Food Science and Technology, University of New South Wales, PO Box 1, Kensington NSW 2033 at a cost of $A12 (includes postage). Make cheques and money orders payable to Dept. of Food Science and Technology, UNSW.

Introduction

he idea for this Symposium arose from the realisation in 1987 that although publication of the new Australian food composition tables, *Composition of foods, Australia* (Cashel & others 1989) was imminent, there had been very little public discussion by intending users about the new analytical data and the associated new tables and computerised data base. Those who had been involved in the analytical work and subsequent publications at the University of New South Wales were conscious of the level of misunderstanding among some readers who had written with requests for clarification of points related to the meaning, derivation or use of the data. These requests had already exposed the lack of training among some users in the scientific meaning and appropriate use of nutrient composition data.

It was therefore decided to hold a meeting which would enable scientists who had been involved in the Australian analytical program to give outline presentations on how the work had been carried out, and to enable some major users in various fields to discuss their requirements and current uses of data. The Symposium was held on 25 and 26 September, 1989, at the University of New South Wales and was attended by about 200 people from industry, health and consumer organisations, hospitals, academia, and research institutions. These Symposium proceedings contain the papers presented on sampling, on data production and analytical quality assurance, and on data scrutiny and compilation. In addition there are papers outlining the use of food composition data and data bases or tables in dietetics, clinical research, nutritional epidemiology, health promotion, food legislation and the food industry, particularly in product advertising. In view of the importance of regional cooperation, there is also a paper on New Zealand's food composition program. A number of recommendations were drawn up by four workshops and agreed to in plenary session. These recommendations conclude the printed proceedings.

In the USA, a National Nutrient Databank Conference is held annually in different states (eg Morgan 1980) and many other countries are now also beginning to hold national meetings (eg FNRI 1985). In Australia the first such meeting was held at the University of New South Wales in 1980 (Greenfield & Wills 1981) and it is hoped that other national meetings will be held from time to time to increase knowledge about the national food composition data base and to learn how to exploit it fully and appropriately. It is anticipated that the computerised data base will become an everyday tool for all working in the field of nutrition in Australia in the coming years. This makes it even more important that users become more informed and knowledgeable about the data and their appropriate use, as well as computer-literate. The power of the computer data base and the situation created by ongoing releases of data and the associated costs could lead to a proliferation of different versions in use, and easy access by untrained users, both situations with the potential for abuse or inappropriate use. It is also clear that nutrient composition data will grow in importance for nutrition education and consumer education. Industry has long recognised the importance of creating its own nutrient data bases and the mutual benefits of the process to industry, research and the consumer alike (Gurr 1989). Other professional groups must not lag behind in knowledge about the nutrient composition of foods and the applications of the data, and should not hesitate to make their voices heard on needs for data and data formats.

The Symposium organisers wish to thank those who participated in the Symposium, including those who displayed posters or who demonstrated software packages, those who assisted with publicity (eg *Food Australia*, the Nutrition Society of Australia, the Home Economics Association of Australia, and regional groups of the Dietitians' Association of Australia), the organisations who sponsored the participation of speakers (Commonwealth Department of Community Services and Health, Canned Food Information Service Inc, National Heart Foundation) and the organisations who assisted with the costs of publication of these Proceedings: CSR Refined Sugars and the Australian Meat and Live-stock Corporation. Finally we thank the many students and staff of the University of New South Wales, who assisted with organisation on the two days of the Symposium.

References

Food and Nutrition Research Institute/National Research Council of the Philippines. 1985. Proceedings of the first national workshop on food composition data generation, compilation and use. Manila: FNRI.

Greenfield, H & Wills, RBH (eds). 1981. Tables of food composition: an Australian perspective. Food Technol. Aust. 33: 101–31.

Gurr, MI. 1989. Has the food industry benefited from the science of nutrition? Proc. Nutr. Soc. 48: 159–63.

Morgan, KJ (ed). 1980. Proceedings of the fifth national nutrient data bank conference. East Lansing MI: Michigan State University.

Composition of foods, Australia

R. English

This paper continues the story about establishing a national data base on the nutrient content of the Australian food supply. At an earlier meeting held at the University of New South Wales (Greenfield & Wills 1981) I presented a paper *Australian food tables — some glimpses into the past* (English 1981). At that time the food analytical program for the current revision had just commenced and the paper detailed the history of the development of food composition data bases in this country. The present paper tells the story behind the present revision program at least up to the publication of the 1989 edition of *Composition of foods, Australia* (Cashel & others 1989).

1978 Working Party on Food Composition Data

The history of the revision program commenced in 1978 when the Working Party on Food Composition Data of the National Health and Medical Research Council (NHMRC) was established and held its first meeting on 22 August 1978. Its terms of reference were: To draw up a plan for the central collection of data on food composition in Australia; to identify the nutrients and other food components (eg additives) for which data are to be collected and the form in which they should be recorded and distributed to the public; and, to identify analytical and research facilities which could participate in a collaborative survey of food composition by direct analysis. The membership of that Working Party comprised:

Professor RH Thorp (Chairman), Australian Federation of Consumer Organisations
Miss June Bullock, Royal Prince Alfred Hospital
Dr Basil Hetzel, CSIRO Division of Human Nutrition
Mr Lesley Ion, Commonwealth Department of Health
Dr WG Murrell, CSIRO Division of Food Research
Mr John Neuhaus, Government Analyst (NSW)
Mr RC Norris, Australian Government Analytical Laboratory
Mrs Barbara Smith, SA College of Advanced Education
Professor Stewart Truswell, University of Sydney
Dr Ron Wills, University of NSW
Miss Margaret Corden (Secretary), Commonwealth Department of Health

The members made a number of recommendations including: the range of foods should be extended from the 1970 edition of the food tables and cover ethnic, processed and fast or take-away foods; a loose-leaf manual form of publication was desirable in which data on nutrients/foods would be grouped by page/section to facilitate updating; and, procedures to be taken to identify appropriate laboratories to participate in the analytical program.

1979 Working Party on Food Composition Data

In 1979, the Nutrition Committee of NHMRC reviewed the report of the Working Party and agreed to recommend the establishment of a steering committee to develop guidelines for the collection of food composition data; urged early

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appointments to the secretariat and technical positions recommended by the Working Party; and, requested that the Council give consideration to the allocation of funds for laboratory analysis.

The first milepost in the revision program was achieved in 1979. This was the establishment of a small Working Party to establish guidelines for the collection of dietary data. The first chairman of the Working Party was Professor Stewart Truswell 1979–1982. Dr Alan Johnson was Chairman from 1982 until his retirement in 1987. The current membership of the Working Party is:

Dr Ross Richards (Chairman), Materials Research Laboratory — Tasmania, Defence Science and Technology Organisation
Mr Wally Hauser, Australian Government Analytical Laboratory
Mr John Harris, Council of the Australian Food Technology Associations
Mrs Ruth English, Commonwealth Department of Community Services and Health
Ms Karen Cashel (Secretary), Commonwealth Department of Community Services and Health

The present amended terms of reference for the Working Party are to recommend to the Nutrition Committee on the program for the revision of *Tables of composition of Australian foods*, and to advise on the laboratory aspects of the program.

Programs since 1979

The work program for the current revision of the Australian food tables is composed of four components: the analytical program; the processing and validation of food composition data and preparation for publication; the establishment of the Australian Nutrient Data Bank to store and process data; and the development of the NUTTAB computer data base.

Analytical program

This program can be divided into two phases, the first being funded by the NHMRC and the second by the Department. Table 1 lists the food analytical programs commissioned by the Council between 1980 and 1984, together with the laboratories and investigators involved, and includes the additional grants made.

Funding for the analytical program was provided by the Council, on a yearly basis only. This meant a major application had to be made to the October Session of the Council each year for funding for the following year — a mountain of paper work!

At the end of 1984, the NHMRC decided the food analytical program was more appropriately funded by the Department than from the Medical Research Endowment Fund and funding was not approved for a program in 1985. However, after very considerable paperwork, the Department stepped into the breach and since 1986 has provided a major funding source through a program grant for food analyses to be undertaken by the Australian Government Analytical Laboratory. To date the Department has provided $400,000 for this program with an allocation of $220,000 in 1989–90, a total of $620,000. Work undertaken within the Department's program grant includes analyses of fish and fish products, cereals and cereal products, milk and milk products, processed fruits and vegetables, legumes, and eggs. The data for these foods will be included in future editions of *Composition of foods, Australia.*

Planning and supervising the food analytical program are very demanding of professional time as they involve developing a national sampling plan for foods to be analysed, supervising the food analytical program, reviewing food analytical methodology, completing administrative paper work for funding for each year's program, requisitioning the actual analytical work, and following up the work program and payment of accounts to acquit annual funds before the end of the financial year.

Nutrients analysed in the program include: water, protein and amino acids*, starch, sugars, total fats, fatty acids, cholesterol, sodium, potassium, iron, calcium, zinc, magnesium, phosphorus*, manganese*, copper*, retinol, carotenes, thiamin, riboflavin, niacin, vitamin C, vitamin B_6*, vitamin B_{12}*, biotin* and dietary fibre* (*denotes analysed on a selected range of foods).

The list of nutrients has been further expanded to include a more complete range of minerals and vitamins in current and future analytical programs.

Validation and processing of data for publication

Major tasks associated with this process commence when the raw data from the laboratory are received in the Department and they are described in detail by Cashel (1990). For this task, a major administrative problem has been obtaining adequate staff resources to expedite the work.

Australian Nutrient Data Bank

The establishment by the Department of the Australian Nutrient Data Bank (ANDB) has certainly expedited the storage, access to, validation and processing of nutrient data both for NUTTAB (Commonwealth Department of Community Services & Health 1987) and the publication of *Composition of foods, Australia.* The development of the ANDB has covered a five year period with significant input from two nutritionists, Karen Cashel and Janine Lewis, as well as computer scientists from the Information Services area of the Department. The first prototype, designed and tested in late 1985, proved to be user-unfriendly and the system was then redesigned with modified objectives. The present system has been up and running for two years now but with changes to mainframe computer systems in the Department, the ANDB now requires major modifications to adapt to the new systems and a case can always be made for extensions to the system.

The ANDB provides for the storage and retrieval of all information relating to food analytical data (Carmody 1987). Data are stored on the specifics of the food, its sampling, handling and preparation, the laboratory, the analytical methods used and the use of the analysis in generating representative data for the nutrient composition of a food. The system provides several advantages. The revised tables *Composition of foods, Australia* are prepared direct from the computer. This allows for a variety of presentation formats and an efficient means of changing or expanding these formats. Updating and expanding the range of both food items and nutrients are limited only by the capacity of the computer, and specialised needs for information can be met.

NUTTAB

Another project associated with the revision program of the food tables and the establishment of the ANDB has been the release in late 1987 of a computer data base NUTTAB providing nutrient composition data on a range of items, covering all major food groups. This data base was released to facilitate the use of Australian food composition values and to encourage the use of a common tool in dietary analysis in Australia.

The 1987 edition of NUTTAB was based on the food composition tables developed to analyse the diets in the 1983 national dietary survey of adults

(English & others 1987) and the 1985 national dietary survey of schoolchildren (English & others 1989). This edition comprised 50 percent Australian data with the balance being modified data from the British food tables (Paul & Southgate 1978).

There have been two updates of NUTTAB, in 1988 and 1989 (Commonwealth Department of Community Services & Health 1989). With updating, there is an increase in the proportion of date based on the current food analytical program. The latest edition now contains some 67 percent of Australian data.

Table 1. Commissioned food analytical program

Year	Title and investigators	Funds
1980	Fruit juices and other beverages (SA Department of Services and Supply)	$22,901
1981	Take-away foods (Professor Wills and Dr Greenfield, University of New South Wales)	$32,692
	Fruit juices and other beverages (Professor Truswell, University of Sydney)	$26,710
	Dietary fibre (Professor Walqvist and Dr Jones, Deakin University)	$21,492
1982	Meat (Professor Truswell, University of Sydney)	$35,349
	Fruit and vegetables (Professor Wills and Dr Greenfield, University of New South Wales)	$31,985
	Dietary fibre (Professor Wahlqvist and Dr Jones, Deakin University)	$22,000
	Standard weight for measure (Mrs Smith, SA College of Advanced Education)	$ 3,750
1983	Meat, fruit and vegetables (Professor Wills and Dr Greenfield, University of New South Wales)	$83,000
	Dietary fibre (Professor Wahlqvist and Dr Jones, Deakin University)	$20,350
	Standard weight for measure (Mrs Smith, SA College of Advanced Education)	$ 4,960
	Preparation of data for publication (Mrs English, Department of Health)	$13,500
1984	Meat, fruit and vegetables (Professor Wills and Dr Greenfield, University of New South Wales)	$96,000
	Dietary fibre (Professor Wahlqvist and Dr Jones, Deakin University)	$20,000
	Standard weight for measure (Mrs Smith, SA College of Advanced Education)	$ 6,160
	Amino acids (Mr Stanhope, Victorian State Chemistry Lab)	$ 7,500
	Microbiological assays (Dr Davis, Royal Perth Hospital)	$ 3,600
	Preparation of data for publications (Mrs English, Department of Health)	$10,000

Composition of foods, Australia

The most visible evidence of the progress made by the national program is the new publication *Composition of foods, Australia* (Cashel & others 1989). This publication provides nutrient data on the food programs commissioned and reported to mid-1987, namely, fruit, vegetables, meats, poultry, offal, take-away and savoury snack products.

The loose-leaf format provides a one page per food overview of the proximate, vitamin and mineral content of the food both per 100 g edible portion and per defined food measure. It also provides a number of specialised appendices eg on fatty acids, sugars, amino acids, organic acids.

It is proposed that the initial edition of *Composition of foods, Australia* will be supplemented by approximately annual issues of further data. These will be mainly additions of new foods. Currently data from the fish and cereal programs are being prepared for release in 1990. However, revisions of updates of food items included in the 1989 issue may be included as new formats or special appendices as requested by users. In fact, consideration is already being given to the minimum information needed to update the data on meats in the near future.

With each new edition of *Composition of foods, Australia* it is proposed to update NUTTAB so that within the next two or three editions, this data base will comprise all Australian data. Other proposed tasks include the long overdue revision of the booklet of simplified food composition tables and development of a reference publication on serving sizes of Australian foods. Whether these proposals come to fruition will be very dependent on the monetary and staff resources made available to the Section to continue this program. It should be noted however, that to this time it is estimated that the cost of analyses and the establishment of the ANDB alone is approximately $1,550,000.

Concluding remarks

Up to 1981 I had been an onlooker as various editions and reprints of the *Tables of composition of Australian foods* (Thomas & Corden 1970) had been prepared in the Nutrition Section prior to 1979 and had appreciated the demanding and unenviable nature of the task. For the 1989 edition of *Composition of foods, Australia* and NUTTAB in which I have been directly involved I would like to pay tribute to the officers who have worked in the Nutrition Section on the day to day detail of this enormous task, Karen Cashel and Janine Lewis with able clerical support from Kerry Pearce.

Acknowledgments to the many people associated with the program appear in the publication *Composition of foods, Australia*, notably the members of the Nutrition Committee and Working Party on Food Composition Data, Dr Heather Greenfield, Professor Ron Wills, Mrs Sue Cassidy and Mr Geoff Hutchison. Lastly, I would like to acknowledge the contribution of the National Health and Medical Research Council and the Department and express my appreciation to these organisations for having faith in and for supporting the program to revise the national reference resource on the nutrient composition of the Australian food supply.

References

Carmody, J. 1987. Development of the Australian Nutrient Data Bank — computer aspects. English, RM & Lester, I (eds). Proceedings of the First

OCEANIAFOODS Conference. Canberra: AGPS. 51–61.

Cashel, K, English, R & Lewis, J. 1989. Composition of foods, Australia. Canberra: AGPS.

Cashel, K. 1990. Compilation and scrutiny of food composition data. Food Australia 42: 8, 521–24/42: 521–24.

Commonwealth Department of Community Services & Health. 1987. NUTTAB87. Nutrient data table for use in Australia. Disk and tape format. Canberra: Commonwealth Department of Community Services & Health.

Commonwealth Department of Community Services & Health. 1989. NUTTAB89. Nutrient data table for use in Australia. Disk format. Canberra: AGPS.

English, R. 1981. Australian food tables – some glimpses into the past. Food Technol. Aust. 30: 103–63.

English, R, Cashel, K, Bennett, S, Berzins, J, Waters, A–M & Magnus, P. 1987. National dietary survey of adults: 1983. No. 2. Nutrient intakes. Canberra: AGPS.

English, R, Cashel, K, Lewis, J, Bennett, S, Berzins, J & Penm, R. 1989. National dietary survey of schoolchildren (aged 10–15 years): 1985. No. 2. Nutrient intakes. Canberra: AGPS.

Greenfield, H & Wills, RBH (eds). 1981. Tables of food composition: an Australian perspective. Food Technol. Aust. 33: 101–31.

Paul, AA & Southgate, DAT. 1978. The composition of foods. London: HMSO.

Thomas, S & Corden, M. 1970. Tables of composition of Australian foods. Canberra: AGPS.

Food composition data and clinical dietetics

D. Foote

An important tool in the repertoire of the clinical dietitian is familiarity with the ingredients and nutrient composition of a wide variety of commonly eaten foods. Formal use of food composition data is made in several ways in the clinical dietetic setting.

Assessment of nutrient intakes

Nutrient intakes of an individual are most commonly assessed from a dietary history or weighed food diary. Using the dietary history method the dietitian questions the subject on his or her usual eating patterns including types and amounts of foods and liquids consumed, and the frequency of consumption of the foods eaten. A dietary history will include an indication of the variation in intake from day to day and of the range of foods typically eaten at each meal or snack time. The dietitian will make estimates of the amounts of food consumed. The food composition tables would then be used to calculate the nutrients obtained from a typical day's intake. These results would only be a guide to the subject's usual intake, being based on so many estimates.

Using the weighed food diary method the subject (or caregiver) weighs or measures, using metric cups and spoons, all food and liquids actually consumed over a period of three or four days. This gives much more accurate amounts than a dietary history, however, there may be some problems. Subjects may alter their usual eating patterns to make the recording easier, or may omit to weigh or record some foods consumed or may not describe foods adequately. A weighed food diary should be done over some weekdays and some weekend days to cover the possible variations between these periods. Nutrient intakes are calculated from the records of foods consumed over the period of the diary then averaged to give daily intakes.

Results from the calculations of nutrient intakes from either a dietary history or a weighed food diary would be compared to the recommended dietary intakes (RDIs) for Australians in the appropriate sex and age group for the subject (National Health & Medical Research Council 1986).

Advice may be given to the subject regarding desirable changes to the diet, based on results of the assessment. If there appears to be a trend to low or excessively high intake of any nutrients such advice may be given, however the dietitian needs to be very cautious in making judgements based on such calculations.

Planning special diets

Most special diets involve controlling the amounts of certain foods eaten according to the relevant nutrients for the medical condition being treated. Reduced or increased intakes of nutrients may be needed. Food composition data allow dietitians to formulate exchange lists giving allowable serving sizes of interchangeable foods, or allowed and disallowed food lists for use in special diets. These lists may be based on different nutrients: carbohydrate for diabetic diets, protein for renal diets, sodium for renal or cardiac diets, potassium or phosphate for renal diets,

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particular amino acids for metabolic disorders, eg phenylketonuria (PKU) and so on for a large number of conditions.

Commercial food lists

In conjunction with diet sheets which list basic foods that are allowed or disallowed on special diets, dietitians will frequently supply commercial food lists. Both nutrient and ingredient composition data of manufactured foods are used to collate lists of foods by brand name which can be included in various special diets. Data are used either to calculate appropriate serving sizes of commercial foods to be used with exchange lists eg diabetic and PKU diets, or to determine allowable foods on diets eliminating particular ingredients, eg gluten- and wheat-free, milk- or egg-free, sucrose-free diets.

Recipe analysis

Another use of food composition data is in analysing recipes. These calculations can be used either for food items which are to be included on a hospital menu or in cookbooks to be supplied to patients on various special diets. Nutrients in each of the ingredients in a recipe are summed and the average content per serving is calculated.

Assessment of nutritional adequacy of hospital menus

In many hospitals, the cycle menu is planned by the food service manager who would frequently ask the dietitian to review the menu for its nutritional adequacy. The dietitian would look for compliance with the Australians dietary guidelines (Commonwealth Department of Health 1981) and may also calculate possible nutrient intakes from various combinations of food choices from the menu. It would be assumed that full meals would be chosen and consumed.

Problems using the *Composition of foods, Australia*

The *Composition of foods, Australia* (Cashel & others 1989) has been released with data for only some of the food groups from new Australian analyses. The new tables still include at the back many foods remaining from the old tables (Thomas & Corden 1977) for which the nutrient composition data are from foreign sources. The dietitian must remember that in different countries the same food name can be given to very different foods which would have widely variable nutrient composition, or the same foods have different names. It is important to keep in mind the variability of many local foods when analysing an individual's dietary intake. Nowadays many dietitians use computerised nutrient analysis of packages frequently based on NUTTAB (Commonwealth Department of Community Services & Health 1988). The information included in this computer data base is not as extensive as in the printed tables and therefore has more limitations in its use.

From a paediatric dietitian's point of view the main difficulty is the lack of compositional data on many of the foods commonly consumed by children eg baby foods, both commercial and home prepared, and infant formulas are still not included. Some food groups still have only a very limited range of individual foods in the tables, eg breakfast cereals, biscuits, confectionery, ice creams, compared with the enormous range available commercially.

Abuses of food composition data

Use of food composition tables by inexperienced unsuitably trained people eg health workers with little or no training in nutrition and food skills, leads to taking imprecise diet histories or food records and then attempting to calculate detailed nutrient intakes from this sketchy information. Such people will frequently be unable to make correct or best choice of the most similar food when a consumed food is not listed in the food tables. Their knowledge of food and nutrients may not be sufficient to know how alike various foods are in nutrient composition or which are the most important nutrients to access in different situations.

Any practitioner (adequately trained or not) can be guilty of making unjustifiably strong judgements based on calculations from a diet history or measured food intake over a small number of days. Both methods of determining food intake are notoriously open to inaccuracies. Accurate assessment of food intake over long periods is necessary before a really definite statement can be made that a diet is inadequate. Nutrient deficiencies can really only be diagnosed in the presence of corroborating biochemical and clinical evidence.

Knowledge of the nutrient composition of foods forms the backbone of clinical therapeutic dietetics. Without access to such data dietitians would be unable to assess patients' nutrient intakes adequately or to give individualised dietary instructions which patients can follow on a long term basis.

References

Cashel, K, English, R & Lewis, J. 1989. Composition of foods, Australia. Canberra: AGPS.

Commonwealth Department of Community Services & Health. 1988. NUTTAB88. Nutrient data table for use in Australia. Disk or tape format. Canberra: Commonwealth Department of Community Services & Health.

Commonwealth Department of Health. 1981. Dietary guidelines for Australians. J. Food Nutr. 38: 111–9.

National Health & Medical Research Council. 1986. Recommended dietary intakes for use in Australia. Canberra: AGPS.

Thomas, S & Corden, M. 1977. Metric tables of composition of Australian foods. Canberra: AGPS.

Food composition data in clinical research

J.R. Allen

In clinical research in nutrition, food composition data are used to evaluate the adequacy of the nutrient intake of individuals or groups. Adequacy means the probability of individuals or groups having an adequate nutrient intake (Beaton 1986). It is difficult to assess nutritional status from food intake data alone. Nutrient intake data are usually correlated with biochemical and anthropometric measurements. The final step is to test for a relationship between the observed nutrient intake and the health or disease state of the study sample. Accuracy in the measurement of food and hence nutrient intake is essential to establish true relationships (Pennington 1988).

The accuracy of the nutrient intake measurement is dependent on the quality of food composition data (Guthrie 1989). The quality of the food tables is determined by the number of food samples analysed, the analytical methods used and the quality control in the laboratory. However, the variability in the measurement of food intakes is greater than the variability in the food composition data (Paul & Southgate 1988).

Sometimes there is a need for direct food analysis, that is, to create the laboratory's own set of food tables. This situation occurs when there is no available nutrient information about a particular food or when the nutrients being investigated cannot be calculated accurately from food tables (vitamin C, sodium, folates). In metabolic balance studies, direct food analysis is necessary to know the intake of particular nutrients accurately.

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Food tables

Errors in the use of food tables can be minimised by following a few simple rules, eg read all the descriptive notes accompanying a set of food tables; note particular items which vary between food tables, such as the factors which have been used to calculate the metabolisable energy in the diet from protein, fat and carbohydrate, the multiplication factor(s) for nitrogen to calculate the protein content of different foods and so on; observe the method for calculation of niacin and retinol equivalents for these may also vary between food data bases. The convention for missing values also needs to be known as a calculation of nutrient intake which leaves missing values as zero will be an under-estimate (Anderson 1986). The extent of this underestimation has been calculated using the British food tables (Paul & Southgate 1978) for a group of pregnant and lactating women (Black & others 1985). It is better to estimate a value from a related food than leave a zero.

Dietary records

There should be a check that the dietary records to be analysed contain enough specific information to enable the correct food item to be identified in the tables. When this specific information is missing it is necessary to make rules about the choice of a food. These rules need to be documented and used consistently in all data coding. For foods or nutrients not listed, information may be obtained from other food tables, manufacturers, food analysis, or substitution with a similar food or a combination of foods to achieve a particular nutrient balance. The methods of food analysis for the missing food need to be similar to those used for the other foods in the diet otherwise an inaccurate calculation of nutrient intake will result.

Recipes require accurate information on the weights of all the uncooked ingredients and the cooked weight of the total recipe. The reduction in weight with cooking is mostly water loss. If the total cooked weight of the recipe is missing, the proportion of the whole recipe eaten can be used in the calculation. When foods gain fat it is preferable to know the fat content before and after cooking (Paul & Southgate 1988).

Manufacturers' information

Information from manufacturers needs to be continually updated as food ingredients are frequently changed, often for economic reasons. It is important to record the date of the manufacturers' nutrient analysis. Usually only a partial nutrient analysis is supplied so the missing values need to be obtained from other sources, as outlined above. If a proportionate list of ingredients (including water) is given, the nutrient content can be calculated from a recipe.

Poor knowledge of nutrition

Another source of error which is difficult to avoid is the use of food tables by people without the appropriate knowledge of food and nutrition to make correct decisions in nutrient analysis of food intake data. This problem seems to have increased with the arrival of computerised food tables.

For the future, food tables may need to include non-nutritive components such as pesticide levels (Anderson 1986). Other needs are ways to reduce time and cost in data processing, improvement of analytical procedures for certain nutrients (eg folates), and a comparison of the different food tables in use. A large unresolved problem in translating food composition data into actual nutrient intakes is the lack of allowance for nutrient bioavailability or interaction between different foods. More information is needed about the proportion of the nutrients actually absorbed from food as eaten.

References

Anderson, SA (ed). 1986. Guidelines for use of dietary intake data. Bethesda MD: Federation of American Societies for Experimental Biology.

Beaton, GH. 1986. Toward harmonization of dietary, biochemical, and clinical assessments. The meanings of nutritional status and requirements. Nutr. Rev. 44: 349–58.

Black, AF., Paul, AA & Hall, C. 1985. Footnotes to food tables. 2. The underestimations of intakes of lesser B vitamins by pregnant and lactating women as calculated using the fourth edition of McCance and Widdowson's *The composition of foods.* Hum. Nutr. Appl. Nutr. 39A: 19–22.

Guthrie, HA. 1989. Interpretation of data on dietary intake. Nutr. Rev. 47: 33–8.

Paul, AA & Southgate, DAT. 1978. The composition of foods. London: HMSO.

Paul, AA & Southgate, DAT. 1988. Conversion into nutrients. Cameron, ME & Van Staveren, WA (eds). Manual on methodology for food consumption studies. Oxford: Oxford University Press. 121–44.

Pennington, JAT. 1988. Associations between diet and health: The use of food consumption measurements, nutrient databases, and dietary guidelines. J. Am. Diet. Assoc. 88: 1221–4.

The uses of food compositional data in nutritional epidemiology

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From the late 1940s until the early 1970s, a series of reviews and studies were published assessing values obtained by use of food tables compared to chemical analyses (Bransby & others 1948, Groover & others 1967, Buzina & others 1966, Pekkarinen 1967, Whiting & Leverton 1960, Eagles & others 1966, Marr 1971). The views expressed in these papers about the validity of food tables for assessment of nutrient intake varied widely but where tables were available for locally produced food products, correlations between calculated and analysed data were generally considered to be good. For example, the early studies of Bransby and co-workers in the 1940s, which compared the results obtained for 33 adults using chemical analyses of three-day weighed records with food table analyses, produced correlation coefficients of 0.93 for energy, 0.91 for protein, 0.81 for fat, 0.89 carbohydrate, 0.80 for calcium but only 0.49 for iron. There was some bias in the data, in that the calculated values for energy, carbohydrate and fat tended to be higher and for protein, calcium and iron, lower, than the analysed figures. However, the differences were small, again with the exception of iron (2053 vs 2088 calories; 76 g vs 68 g protein; 81 g vs 84 g for fat; 255 g vs 265 g for carbohydrate; 1.1 g vs 1.0 g for calcium and 19 g vs 11 g for iron). An analysis of the relative ranking of subjects using tertiles also showed that 70–80% of subjects remained in the same extreme tertile of intake comparing analysed and calculated values. Again, however, the matching for iron was poor with only 50% remaining in the same extreme tertiles and 20% being grossly misclassified. Marr, in her review in 1971, concluded that Bransby's data and the other data available to that time, showed that, whilst absolute agreement for every individual is not achieved with the use of food tables, there is a high degree of correlation for most nutrients, such that it is possible to compare groups of individuals in terms of their broad distributional properties and to rank them, two common needs in epidemiologic or population-based research.

In recent years, nutritional methodology issues have continued to receive wide coverage both in the epidemiological and nutritional literature. There have been extensive discussions on techniques and the validity of various methods to assess usual or current intake and how best to express the resulting data. However, despite the large number of recent publications and the many national and international workshops and symposia on these topics in recent years (Baghurst & Baghurst 1981, Block 1982, Stuff & others 1983, Byers & others 1985), there has been relatively little discussion of food composition data bases, their use and abuse.

The nature of epidemiological work

The lack of discussion about the validity and use of food tables in the epidemiological field, probably relates, in part, to the fact that no realistic alternative approach to the analysis of population-based dietary intake data exists. Epidemiological work, by its

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nature, involves studies of large numbers of people. These studies can be cross-sectional or prospective in nature, in which case a measure of current usual dietary intake is often required, or they can be retrospective, in which case past usual intake is the item of interest. The studies may involve a case-control or cohort design but in both cases, the main purpose is usually to compare relatively large groups of individuals. Therefore the need for absolute accuracy is not as great as when trying to assess, for example, the carbohydrate intake of a single diabetic patient in a clinical setting. A systematic error in the food data base, such as may occur when an analytical technique for a given nutrient gives consistently high or low values across all foods, will not markedly affect the final outcome of a case-control or cohort study where comparison between groups is the issue, but may cause problems to the user wishing to assess absolute intakes in an experimental or clinical setting. On the other hand, random errors or biases in the food composition data base can cause problems even in comparative studies. For example, if one particular food or category of foods is eaten more often in one group than in the other, errors in analyses for those foods will bias the comparison, making differences between the groups bigger or smaller than they are truly.

Computerisation of data bases

A major area of concern in relation to the use of food tables in epidemiological work is that they are often used by people not trained in any way in their use and, indeed, often with no nutritional training at all. The increasing availability of predesigned computer packages for analysing diets will only compound this problem by further distancing the user from the producers of the tables.

Food compositional data bases, in their printed form, often have extensive notes detailing the source of data, selection of items for analysis, the range of values found, the analysis techniques used and any assumptions made when calculating values for items or nutrients not directly measured. They also carefully annotate missing data for a given food. This information is rarely available in computer packages. Indeed in many computer packages missing values are entered as zero rather than using best estimate figures. In a major recent review of the use of dietary intake data, Anderson (1986) estimated that use of zero figures for missing data was the major potential error source in food tables. Unless the users of tables have an original copy of the annotated data, and unless it is also possible for them to amend errors in any computerised data base they may use, biases will inevitably be introduced into their dietary intake analyses. Unfortunately, many users of computerised food tables will not avail themselves of the printed or original computerised tables because of the additional costs.

The increasing use of food data bases by non-specialists also reinforces the need to annotate tables and programs carefully to prevent common coding errors such as the use of codes for dried items (coffee grounds, cocoa powder, gravy powder or custard powder) when the appropriate code is for the rehydrated form. There is also a need to avoid ambiguous labelling such as ‘beef, fat’, a code descriptor used in one widely used table to mean the fat from beef. In our experience, the code for ‘beef, fat’ has often been used mistakenly when attempting to code fatty beef. This problem may be compounded in computerised programs if abbreviated food descriptors or abbreviated food tables are used. It should be possible to overcome these problems by careful naming of items or by the use of warning messages where known potential problems exist. In short, computer programs which include the use of food tables need to be more user-proof.

Specific needs of epidemiologists

The needs that nutritional epidemiologists have in relation to food compositional data bases are, in most respects, similar to those of other users. The data base would contain accurate and comprehensive nutrient and non-nutrient analyses (nitrates, nitrites, oxalates, phytic acid, additives, contaminants etc) for all major food items eaten by Australians, including a wide range of foods commonly consumed by ethnic communities and by the more traditional aboriginal groups.

The range of nutrients and non-nutritive components of the food supply that are of interest to epidemiologists, and especially to cancer and cardiovascular epidemiologists, is far in excess of those currently available or indeed immediately planned for the Australian data base. For example, despite the fact that Australia has recently developed recommended levels of intake for nutrients such as vitamin E and selenium, we have little or no data on the levels of these nutrients in Australian foods. Indeed, there are few overseas data on these nutrients or other non-nutritive components such as nitrites, nitrates and nitrosamines, which are of great interest in cancer epidemiology. The relevance of the overseas data that do exist is difficult to assess as items such as selenium and nitrates and nitrites are highly dependent on the soils in which foods are grown and on related farming practices. Others such as vitamin E are also dependent on the commercial usage of various fats and oils. Other nutrients which would be of particular interest to cancer epidemiologists for similar reasons, include manganese and various carotenoids (including not only those which are precursors of vitamin A such as β- and α-carotene and β-cryptoxanthin, but also non-provitamin A carotenoids such as lutein and lycopene). In the cardiovascular field, the pressing need is for further data relating to fatty acid profiles of fats and oils from various sources, including local varieties of fish, and to the various dietary fibre components of foods (when measurement issues relating to the latter have been resolved).

Many nutritionists involved in population-based research would prefer to have accurate data for a wide range of nutrients in key or basic foodstuffs than to have limited nutrient information on a wide range of foods, some of which are very rarely eaten and only contribute marginally to overall nutrient intake in the population group of interest. In this regard, it is particularly important to have these accurate analytical data, together with details about their reliability and the range of values for specific nutrients in given foods, where those foods are major contributors to population intakes of the nutrient. For example, it is more important for the assessment of population figures of β-carotene intake to have exhaustive data for β-carotene in carrots which are the major and dominant population source of this nutrient. Small inaccuracies in tables due to analyses of samples limited in terms of their source, cultivar, stage of maturity etc will have a marked effect on the accuracy of population intake figures for carotenes whereas similar or even larger inaccuracies related to other minor sources such as nectarines would have a negligible effect. The same concern relates to the representativeness of analytical data for dietary fats and oils in relation to fatty acid profile and vitamin E for which they are dominant sources; to liver and kidney for items such as retinol and vitamin B12; and to eggs for cholesterol. It is also essential to have accurate and detailed data for basic foodstuffs such as breads which can come in a wide variety of types and which contribute substantially to a wide range of nutrients.

Food tables are often used by epidemiologists and other research workers to aid in the design of questionnaires relating to food intake. In many instances, the researcher is seeking to determine which food to include in a questionnaire, or which to take into consideration in computing dietary intakes, and would be aided in this by the inclusion, in both printed and computerised data bases, of nutrient content per usual serve size as well as per 100 g. In addition, many inexperienced users need an indication of the relative importance of consumption of various foods when assessing nutrient intakes at the population level. This would prevent the common occurrence of a key food or foods being omitted from questionnaires on the basis of relatively low levels of nutrient per 100 g or serve, when in fact the frequency of consumption of that food is high and the usual serve size is large. In short, it must be remembered that the nutrient contribution that a food makes to a given diet, is a function not just of its chemical composition, but also serve size and frequency of consumption.

An additional aid to the user would be the inclusion of condensed lists of nutrients as well as the more common page-by-page, screen-by-screen or line-by-line food lists. For example, a few pages or screens listing fat levels in all foods, either per 100 g or per serve, would be a time-saving device for those wishing to concentrate on fat intakes.

Continuous updating of tables

One problem which epidemiologists, and other users in Australia, will have to face in the coming years will be how to cope with a data base in continuous evolution. This is a particular problem in epidemiological work where changes in intake over time are being monitored or where one wishes to compare the results from various studies. It will clearly be necessary for all research workers to describe in detail in their publications, which of the various versions of the Australian or other tables they have used in their analyses, while those undertaking longitudinal studies should use a consistent data base with the possibility of having to recompute earlier data sets.

The rolling nature of data release in Australia may also cause problems with the use of computer packages for dietary analysis. Due to their high cost, purchasers will be reluctant, or unable, to repurchase such packages each time NUTTAB, the computerised form of the Australian food tables (Commonwealth Department of Community Services & Health 1989), is updated especially if the need for reprogramming has increased the costs. Clearly a system that can be updated readily and cost-effectively will be needed in the coming years to avoid non-standardised usage.

Conclusion

In conclusion, a reliable and comprehensive food composition data base for Australian foods is essential for nutritional epidemiology research and for other population-based surveys. Although it is possible to assess nutrient status, in some instances, using biomedical indices or chemical analysis of duplicate diets, the size of the sample populations and the wide range of nutrients usually of interest, prohibits this approach in all but a small number of applications. The usefulness of the new Australian food tables (Cashel & others 1989) could be enhanced considerably if funds were available to speed up the release of data for other major food groups and to include analyses, at least for key foods or food groups, for components such as vitamin E, manganese, selenium and nitroso-compounds for which there are no local data and few relevant overseas data available.

References

Anderson, SA (ed). 1986. Guidelines for use of dietary intake data. Bethesda MD: Federation of American Societies for Experimental Biology.

Baghurst, KI & Baghurst PA. 1981. The measurement of usual dietary intake in individuals and groups. Trans. Menzies Found. 3: 139–60.

Block, G. 1982. A review of validations of dietary assessment methods. J. Am. Diet. Assoc. 87: 43–7.

Bransby, ER, Daubney, CG & King, J. 1948. Comparison of nutrient values of individual diets found by calculation from food tables and by chemical analysis. Br. J. Nutr. 2: 232–6.

Buzina, R, Keys, A, Bordarec, A & Fidanza, F. 1966. Dietary surveys in rural Yugoslavia. III. Comparison of three methods. Voeding 27: 99–105.

Byers, T, Marshall, J. Fiedler, R, Zielezny, M & Graham, S. 1985. Assessing nutrient intake with an abbreviated dietary questionnaire. Am. J. Epid. 122: 51–4.

Cashel, K, English, R & Lewis, J. 1989. Composition of foods, Australia. Canberra: AGPS.

Commonwealth Department of Community Services & Health. 1989. NUTTAB89. Nutrient data table for use in Australia. Disk format. Canberra: AGPS.

Eagles, JA, Whiting, MG & Olsen, RE. 1966. Dietary appraisal — problems in assessing dietary data. Am. J. Chin. Nutr. 19: 1–9.

Groover, ME, Boone, L, Houk, PC & Wolf, S. 1967. Problems in the quantitation of dietary surveys. J. Am. Med. Assoc. 201: 8–10.

Marr, J. 1971. Individual dietary surveys: purposes and methods. World Rev. Nutr. Diet. 13: 105–64.

Pekkarinen, M. 1967. Weighing methods in dietary surveys. Voeding 25: 26–31.

Stuff, JE, Ganza, C, Smith, ED, Nichols, BJ & Montandon, CM. 1983. A comparison of dietary methods in nutritional studies. Am. J. Clin. Nutr. 37: 300–5.

Whiting, MG & Leverton, RM. 1960. Reliability of dietary appraisal: comparisons between laboratory analysis and calculation from food tables. Am. J. Publ. Health 50: 815–23.

Food composition data and the National Heart Foundation's Food Approval Program

B. Haddy

The National Heart Foundation (NHF) is a nongovernment, non-profit community health organisation formed in 1959. For 30 years the Foundation has been encouraging people to stop smoking, exercise regularly, maintain normal weight and eat sensibly. Some of these messages seem to have worked as there has been a steady fall in premature heart disease deaths in Australia since 1967 resulting in a saving of some 103,000 lives in the 20-year period to 1987. However, much remains to be done as cardiovascular disease still accounts for just under 50% of all deaths and Australia still ranks high in international comparisons for coronary heart disease (NHF 1987a).

Until recently probably the most controversial aspect of the Heart Foundation's activities was the anti-smoking area. Many individuals and organisations became more hostile towards the Foundation as its anti-smoking messages, when combined with the efforts of other similar organisations, became more and more successful. This threatened the profitability of the tobacco industry and tobacco retailers, restaurateurs claimed that they would lose revenue if a smoking ban was implemented and sporting groups believed their traditional funding sources were under threat.

The NHF Food Approval Program

Given this background it was expected that when the Foundation undertook an initiative to change behaviour in the dietary area it would meet opposition from various quarters. The initiative is the Food Approval Program which offers food manufacturers and producers the opportunity to use a special *National Heart Foundation Approved* logo on their products.

When the Foundation launched this Program earlier this year, it generated lively debate within the food industry and amongst health professionals. This review of the Program discusses the various benefits which it can offer the Australian community and offers some responses to several common criticisms of the Program.

First of all the Program has been based, to some extent, on a Heart Food Festival which was conducted by the Foundation in April 1987 and which offered food manufacturers the opportunity to use a special logo on food products (NHF 1987b). Although only a short term campaign, a subsequent evaluation showed that over 40% of the population were aware of the project. Positive feedback was also received from a broad cross-section of the food industry (NHF 1987c). It was realised that an on-going food approval program had a real chance for success in terms of both consumer and industry acceptance. Therefore the Foundation's Diet and Heart Disease Committee commenced work on a set of acceptability criteria for approved foods, a laboratory was appointed to test all foods prior to approval and a licence fee structure was established to provide on-going funds for the promotion of the Program and related education activities. A simple, distinct logo featuring a stylised tick was also devised.

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Acceptability criteria

The acceptability criteria for various foods rely heavily on nutrient composition data. The earlier experience with the Heart Food Festival had originally forced the Foundation to look carefully at individual food composition data. For the Food Approval Program the NHF Diet and Heart Disease Committee carefully studied each type of food in turn to arrive at levels it considered appropriate for total fat, saturated fat and sodium, in particular, as well as for dietary fibre, cholesterol and added sugar levels for some food categories. In many cases the acceptability criteria developed have been aligned with definitions in the National Health and Medical Research Council's Food Standards Code (1987) for low or reduced levels of fat and salt. In other cases, usual serving sizes, the broader nutritional value of the food concerned and the availability of lower fat or lower salt substitutes in the marketplace all contributed to the establishment of the criteria (NHF 1989).

Food analysis

The Foundation appointed the South Australian Regional Laboratory of the Australian Government Analytical Laboratories (AGAL) some nine months ago to undertake all its analysis work to test the foods prior to approval. Six different batch samples must be submitted for any food for which a manufacturer is seeking approval and AGAL uses widely-accepted analytical techniques for determining moisture, total fat, fatty acid profiles, sodium, total sugar, sugar profiles, cholesterol and dietary fibre.

Program benefits

The effect of promoting the Food Approval Program acceptability criteria to the food industry has already had a considerable effect in many companies. For the first time, real guidelines are now available for companies wishing to develop and promote low saturated fat and low salt products and the approval logo offers a tangible marketing incentive.

Consumers have also responded very positively to the Program as it provides a quick, easy guide to the type of foods the NHF recommends as part of healthy eating. By influencing some of the food choices people make, the Foundation hopes to improve the national diet and lower the incidence of diet-related health problems.

Food choices are also being affected through the Foundation's input into the advertising of approved products. All companies participating in the Program must sign a legal agreement with the NHF which stipulates prior approval for all advertising copy featuring the approval logo. Through this mechanism, the NHF tries to help ensure food advertising is factually correct and responsible.

A final plus for the Program is that it is generating a significant food analysis data bank which NHF hopes to publish at some future time. Assuming the co-operation of food companies concerned, the NHF expects to be able to publish brand-specific data which would undoubtedly be of great help to many dietitians.

Criticisms of the Program

One of the common criticisms of the Program by some sections of the food industry is that the NHF is artificially dividing foods into “good” and “bad”. In response, the Foundation has never claimed that consumers should only eat *NHF Approved* foods and has widely acknowledged that many foods not in the Program can be part of a healthy diet. The Program is intended to simply be a general guide to low saturated fat, low salt foods and our accompanying education resources highlight this point.

Some nutritionists have criticised the Program because of its perceived focus on individual foods rather than the total diet. The Foundation is very mindful of this concern and is therefore continuing to put the Program into the context of overall healthy eating. Program posters, literature and publicity reinforce this point further.

Conclusion

The NHF believes the Food Approval Program will become one of the most successful nutrition education initiatives ever undertaken in Australia. However, this success will not occur overnight and requires input form both the food industry and health professionals. This will allow finetuning of the Program to maximise its potential for improving the nation's health status.

References

National Health & Medical Research Council. 1987. Food Standards Code. Canberra: AGPS.

National Heart Foundation. 1987a. Heart Facts Report 1987. Canberra: NHF.

National Heart Foundation. 1987b. Heart Food Festival 1987. Report No. 1. Canberra: NHF.

National Heart Foundation. 1987c. Heart Food Festival 1987. Report No. 2. Canberra: NHF.

National Heart Foundation. 1989. Guidelines for acceptability. Canberra: NHF.

Sampling of foods for nutrient composition studies

J.H. Cunningham

Sampling of foods for analysis, and their subsequent preparation prior to analysis, are critical steps in the production of good quality and useful food composition data. If sampling and sample preparation are done incorrectly then all subsequent analyses are a waste of time and money, as a mistake in sampling can only be corrected by repurchasing and repreparing the sample. This review of the process of sampling and sample preparation for nutrient composition studies is written from a practical viewpoint pointing out important considerations and likely pitfalls. Sampling considerations are relevant not only to those who will actually be involved in the generation of data or the preparation of tables; users of food composition tables should also be aware of the factors that influence sampling and hence the analytical data ultimately reported.

In the present context, sampling is the selection and collection of items of food defined in number, size and nature to represent the food under consideration; and the consolidation and reduction of the collected items to form the portion for analysis (Horwitz & others 1978).

The aim of sampling for food composition purposes is to obtain an analytical sample that is representative of the foods available to, or consumed by, the population concerned (Greenfield & Southgate 1985). This aim implies that the participants in the program have a detailed knowledge of the population in question and its food habits. In general, food samples obtained from a single source or produced under special conditions are not suitable for generation of data for food composition tables as they are rarely representative of the foods available to the majority of the public (Greenfield & Southgate 1985). Before any samples of food are purchased for a food composition program, a sampling plan should be developed and assessed critically to ensure that the foods purchased will be representative of those available. The analyst and program supervisor should be closely involved in the development of the sampling plan. In Australian studies the usual practice for obtaining representative samples has been to sample foods available in the major urban areas due to constraints of cost and distance. In contrast, however, the bush foods program at the University of Sydney analysed samples primarily collected in the Northern Territory by Aborigines, Aboriginal health workers and dietitians (Brand & others 1983).

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Type and source of food to be analysed

Within the general category of foods to be analysed a survey should be carried out of the range of products available and their sources. The same general type of food may be available from a range of outlets (restaurants, supermarkets, delicatessens, take-away food shops, fast food chains, health food shops), in a range of forms (fresh, frozen, canned, dried) and from a number of manufacturing sources (factory-processed, home-made etc). For example, in a 1981 study of Greek foods samples were purchased from delicatessens, restaurants and takeaway food bars (Greenfield & others 1983).

If a food is factory-produced it is likely to be relatively consistent in nutrient composition regardless of where it is purchased. Fresh produce, restaurant foods or home-made foods are much more likely to show wide variations in composition according to their source and the chosen sampling plan must reflect this variation. The more variable in nutrient composition a food is likely to be, the greater the number of samples that should be purchased to achieve a representative result. For example, in the University of NSW nutrient analysis programs the approach used has been to purchase four units of standardised food, such as a manufactured breakfast cereal, and ten units of non-standardised foods, such as meat pies produced in different small cake shops (Wills & others 1988).

One important variable that may affect non-factory produced foods is the socio-economic status of the area in which a sample was purchased. In a large program of analysis of the composition of Australian fresh meats, a sampling plan was devised, based on published demographic and social studies, dividing Sydney into ten ranked socio-economic areas and then selecting one suburb out of each of these ten areas from which to purchase meats (Greenfield & others 1987). Some foods of the type being examined may only be available in certain suburbs or towns; for example some fresh delicatessen-style products may be readily available in a yuppie suburb but may be unheard of in a middle class mortgage belt suburb. Similarly foods consumed by particular ethnic groups may only be readily available in certain cities or certain welldefined suburbs.

Suppliers of foods for analysis should not be made aware of the purpose for purchasing, to reduce bias in samples and the subsequent analytical results.

Type of representative sample

Ideally if one were to purchase ten units of a food sample (eg Valencia oranges) then each unit would be analysed separately and the final result calculated as the mean of these units. Such samples are referred to as single replicate samples. As this is obviously an expensive approach it is infrequently used and an approach described as single composite sampling is more common. With single composite samples, the ten units of Valencia oranges would be mixed together to produce a composite sample for analysis. A third class of sample is the multiple composite sample where foods from different regions, seasons, cultivars or brands are combined together to form one composite sample. Continuing the analogy of oranges, Washington Navel and Leng Navel oranges would be combined with Valencia oranges to form a composite sample called ‘oranges’. The multiple composite approach is most suitable for foods that are not staples of the diet, such as specialty fruit or frozen pizza (Greenfield & Southgate, 1985). If the food in question is a significant component of the diet separate samples are usually drawn for different cultivars, different growing areas, different seasons and different processing and preparation methods.

Trial runs

A trial run of the entire procedure should always be done to identify and resolve problems prior to the actual purchase of samples for analysis. Typical problems and questions include: what type of transport is needed? (is a small car satisfactory or will a delivery-size van be required?); what type of containers are needed for sample storage during transportation? (perishable products need to be placed directly into insulated containers); how long will it take to visit every outlet required? (in large cities it can take one or more working days just to collect the samples); if samples are being flown in from overseas, customs and quarantine clearances will be necessary; is there enough storage space in the refrigerator and freezer at the laboratory to store all the samples before and after preparation?; how long does it take to prepare one laboratory sample?; what equipment is needed to prepare and homogenise the sample?; is there sufficient time remaining on the day of preparation to perform the immediate analyses of moisture and vitamin C? (reagents and equipment should be prepared in advance for these analyses); is there a washing-up area readily available?; if samples are to be cooked are there hot plates, ovens and utensils available?

Sample preparation

Sample preparation often generates many problems. When dealing with perishable foods it is preferable to purchase only a few samples at a time so that the preparation and immediate analyses can be completed rapidly and without mistakes. A range of standard kitchen equipment is needed to prepare samples prior to analysis. This equipment includes cutting boards, knives, spoons, spatulas, strainers, bowls, blenders or homogenisers, plastic storage bags, aluminium foil and indelible marking pens. Plastic utensils are desirable where possible to reduce the risk of metal contamination. Ideally, a food composition laboratory will have a dedicated set of utensils as well as a dedicated sample preparation area. The sample preparation area should be free from environmental contamination such as dust and insects, particularly when trace metals are to be analysed.

Registering the sample

All relevant details about the sample should be entered immediately into a bound register. Loose pages are not acceptable as they can become lost. Registration details can be transferred at a later time to a computer system but it is often impractical to site a computer close to a messy food preparation area. Details that should be recorded about the sample include: common names(s), sometimes the same food will have different common names in different areas or among different ethnic groups and as many common names as possible should be reported; systematic name for plant foods or seafoods (in particular); serving or purchase size in grams or millilitres; edible portion weight together with a description of the material constituting both the edible and inedible portions; description of the state of the food as purchased (whether raw, cooked, frozen etc.); description of the components of the foods (eg the proportion of pastry in a pie) with photographs if possible; date marking or product code if available; place and date of purchase; name and address of manufacturer, if available; label claims and ingredient lists, if provided; details of the cooking method, if the sample is subsequently cooked (Greenfield & Southgate 1985).

Cooking of samples

Care must be taken in the selection of cooking method when samples are to be cooked prior to analysis. Popular cookbooks should be consulted to obtain recipes. In the case of foods from another culture, advice may have to be sought from members of this culture. For packaged foods it is acceptable to follow the manufacturer's instructions. If oil, fat or water are added during the preparation this should be recorded and, in the case of fats, the type of fat noted. Other details such as the amount of sample cooked, time and temperature of cooking and the type of cooking method and utensils must be recorded. Samples should be weighed before and after cooking (Greenfield & Southgate 1985).

Homogenising the sample

If reproducible, reliable results are to be obtained the laboratory sample must be reduced to a homogeneous mass. A poorly homogenised sample will invariably give nonreproducible results. A study by Wills & others (1980) found that domestic food processors were as effective as special laboratory homogenisers in obtaining homogeneous samples for a range of foods. Many foods are extremely difficult to homogenise and food processors may not be entirely satisfactory. In this case additional equipment and trials are required. For hard, dry foods such as grains and legumes it is generally necessary to use a laboratory mill or a coffee grinder. However the extensive grinding required can result in metal contamination of the food leading to high iron levels. A solution to the problem of metal contamination may be to use samples coarsely ground, by a mortar and pestle for mineral analysis, and a finely ground sample for the remaining analyses. Although sieving will remove large pieces of food some component of the food, such as the bran, may be selectively removed also. Extensive blending or grinding may produce sufficient heat to damage some vitamins. Sticky or sugary foods may require coarse grating and mixing rather than homogenisation. This is, however, likely to result in a greater degree of variation between analytical duplicates in subsequent analyses. Excessive blending of high oil content foods such as nuts should be avoided as the oil may separate. Similarly some fruits such as bananas or papaya should be mashed rather than blended at high speed.

During the process of sample preparation it is important to minimise sample exposure to light, air and heat as these will lead to destruction of vitamins. At least 500 g to 1000 g of sample should be obtained if possible. This should provide sufficient material for the inevitable repeat analyses.

Storing the sample

Samples should be stored in such a manner as to minimise deterioration or change in nutrient composition. Usually samples are frozen although some researchers have used freeze-drying (Brand & others 1983). Frozen samples must be stored in containers that are impervious to water. Strong polythene bags are satisfactory and cost-effective; the sample should be placed within three bags to minimise the risk of leakage, each bag being carefully sealed (eg with a heat sealer) and clearly labelled with the product identity. Plastic bags may not be suitable for high water content foods such as fruits, as the sample may swell when frozen and burst the bag. Rigid plastic dishes with strong seals may be used as an alternative. Headspace within solid containers should be minimised to reduce the likelihood of sample oxidation. Glass containers should be avoided where possible due to the risk of breakage. Code names on sample labels should be avoided unless an efficient and permanent record for deciphering the code is available. The homogenised samples should be divided into at least two separate sub-samples which should, preferably, be stored in different freezers to avoid the loss of all sample material in the event of a thaw-out. During frozen storage some of the water or fat in samples may separate out; in this case it is necessary to reblend the sample prior to taking an aliquot for analysis.

Conclusion

During the process of sampling and sample preparation compromises will have to be reached. Indeed the entire process of sampling can be regarded as a compromise because it is clearly impossible to sample every piece of food throughout the country. Provided the sampling process is approached with knowledge, a clear mind and careful planning this most vital of steps in a food composition program will, however, be successfully negotiated.

References

Brand, JC, Rae, C, McDonnell, J, Lee, A, Cherikoff, V & Truswell, AS. 1983. The nutritional composition of Australian Aboriginal bushfoods. I. Food Technol. Aust. 35: 293–8.

Greenfield, H, Lerogiannis, V, Makinson, J & Wills, RBH. 1983. Composition of Australian foods. 19. Greek foods. Food Technol. Aust. 35: 84–6.

Greenfield, H, Kuo, YL, Hutchison, GI & Wills, RBH. 1987. Composition of Australian foods. 33. Lamb. Food Technol. Aust. 39: 202–7.

Greenfield, H & Southgate, DAT. 1985. A pragmatic approach to the production of good quality food composition data. ASEAN Food J. 1: 47–54.

Horwitz, W, Cohen, S, Hankin, L, Krett, J, Perrin, CH & Thornburg, W. 1978. Analytical food chemistry. Inhorn, SL (ed). Quality assurance practices for health laboratories. Washington DC: American Public Health Association. 545–646.

Wills, RBH, Balmer, N & Greenfield, H. 1980. Composition of Australian foods. 2. Methods of analysis. Food Technol. Aust. 32: 198–204.

Wills, RBH & Greenfield, H. 1988. Laboratory instruction manual for food composition studies. Kensington NSW: University of NSW, Dept. of Food Science & Technology.

Data production and quality assurance in a nutrient analysis program

P. Scheelings and D. Buick

A nutritional analysis program extends beyond the collection of a trolley of foods at the corner supermarket and analysing the products for a variety of nutritional components. Such a program requires an understanding of the size and complexity of the project and a careful assessment of the resources, skills, courage and discipline required to progress the task to completion (Scheelings 1987). It is as much about program planning as it is about analysis and more about data evaluation than reporting.

This review covers the process of data generation and identifies the critical elements of quality assurance for a nutrient analysis program. It is based on four years involvement in food compositional analysis for the Australian food tables program, as well as for nutritional labelling of packaged foods and nutrient stability studies in processed foods, leading to considerable experience in the associated activities of sampling, transport and storage, analytical strategies, methodology and data reliability.

Data production

Data production can be defined simply as the generation of analytical data by machine, analyst or organisation. The usefulness of the data, however, is a function of its reliability and requires correct program design, planning and execution, and thorough data evaluation.

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The provision of reliable nutrient data requires the analytical laboratory to understand the objectives and limitations of the food composition program, the end use and application of the data, and the knowledge and qualifications of the commissioning client. Likewise the client should have some appreciation of the complexities of the analytical task, be able to assess the proficiency of the contract laboratory, have some knowledge of the natural variability of nutrients in foods, understand the statistical basis for sampling procedures and preferably have some knowledge of the principles of analytical quality control and assurance in chemical measurements.

Sampling

Much has been written on the importance of representative sampling and the value of considered sampling plans (Taylor 1987, Garfield 1989). Representative sampling for nutritional analysis for food composition tables poses particular difficulties.

A fundamental difference between regulatory or quality control analysis and food composition analysis is the size of the sample lot or population. In regulatory analysis, the size of the sample population is well defined. The sampling plan merely needs to provide for a representative sample of the population or consignment, taking into consideration the size or volume of the lot and the physical state and homogeneity of the product. In on-going programs such as the National Heart Foundation Food Approval Program (Haddy 1990), the sample population is less defined in terms of size, and analysis is performed on a representative test sample which describes as best as possible the product at the time of sale. In the Food Approval Program representative sampling involves the submission to the laboratory of at least six individual samples taken from different production batches. The laboratory sample is prepared by compositing and homogenising the samples submitted and test samples taken from the homogenate using appropriate sampling procedures. The analytical data so produced are normally valid for an agreed period of time (eg 12 months) after which period the product is resampled and submitted for re-analysis.

Due to the high cost of analyses and the extensive range of nutrients normally involved, data produced for food composition tables, however, demand greater durability. In these analytical programs the size of the sample population is even less definitive and the samples taken for analysis can only represent a snapshot of a changing population. It is important that this limitation is both recognised and accommodated in any sampling plan.

Critical steps in data production

The normal sequence of activities in the production of data by the laboratory is described below.

Commissioning

The client submits a request for an analytical service, the laboratory advises on its capacity to undertake the work and provides a quotation and estimated turn-around time; then a contract is signed if parties are agreeable and the laboratory is advised on sampling protocol, documentation requirements and transport.

Sampling

Samples are taken by the client or the contract laboratory in accordance with the specified sampling plans; the samples are delivered to the laboratory and checked for integrity, documentation and transport duration; sample information and analytical requirements are detailed in a sample register and a laboratory worksheet is produced and sent with the samples to the analyst or supervisor.

Analyses

The priority of the task is assessed taking into consideration client requirements, sample stability and laboratory workload. In nutritional analysis, care must be taken to ensure that sufficient time is available to complete analyses for vitamins with limited stability. Highest priority must be given to moisture and the more labile vitamins (eg vitamin C, carotenes) which are often analysed in individual samples. Then client samples are composited, where necessary, and homogenised to produce a laboratory sample. Test portions are taken from the laboratory sample for analysis. An equal number of laboratory samples are frozen and used as duplicates or retest samples in case of dispute or unusual results. The appropriate methods are selected which provide reliable data for the particular food matrix. Universal methods which are applicable to a wide range of food commodities are preferred. In addition, alternative methods such as bio-assays may be employed as check methods for some vitamins. When analyses are completed, and acceptable recoveries and duplicates are obtained (ie evidence that the analytical system is in statistical control), the data are reported on the worksheet and submitted to the supervisor.

Data checking and reporting

The supervisor confirms the validity of the results by checking calculations, examining chromatograms and other raw data. When all the results are available, the data are again scrutinised and checked against expected or reported values. Outlying data may be confirmed by re-analysis. Final data are entered on the computer, and a report of analysis prepared for the client. A report should provide sampling details where appropriate, analytical results, precision data and methodology and be signed by the supervising analyst. If required, laboratory staff should be available to interpret the data or discuss aspects of the methodology employed with the client.

Quality assurance in nutritional analysis programs

In the context of analytical services, data production is concerned with the output of quality data, ie data which are reliable, timely and cost-competitive. Most clients have a clear understanding of time and an even clearer one of cost but generally lack an appreciation of the statistical concepts of data quality.

Analysts and service laboratories are able to provide a quantitative measure of data quality by reporting the uncertainty limits of the measurements involved and describing the quality assurance parameters employed. This is formalised through the existence and use of a quality assurance plan which is an integral part of any Good Laboratory Practice (GLP) protocol. The important elements of a GLP protocol include the employment of competent and qualified personnel, a modern wellequipped laboratory environment, the use of appropriate and validated methods, the use of experienced analysts, proven proficiency in the analytical methods, routine use of appropriate analytical standards and reference materials, comprehensive sample and data recording and reporting procedures, protocol for sample chain of custody, attention to customer service, attention to staff training and development and occupational safety and health, a professionally stimulating work environment, and, sound technical and administrative management.

Quality control

Quality control can be defined as the overall system of activities whose purpose is to provide a quality service or product which meets the need of the user. Quality control in an analytical laboratory covers personnel, equipment and methodology and promotes procedures such as replicate analyses and use of spiked controls and split samples.

Quality assurance

Quality assurance describes a system of activities whose purpose is to provide assurance that the quality control tasks are being performed effectively. This is normally achieved through regular quality audits, use of blind samples, participation in proficiency studies and external laboratory assessments. The effectiveness of the quality assurance process determines the reliability of the data produced by the laboratory. The term reliability means the data produced by a laboratory are accurate (close to the correct value) and precise (able to be reproduced).

Selection of analytical methods

In selecting analytical methods the following parameters need to be given due consideration (Horwitz & others 1978): specificity, sensitivity, detectability, accuracy and precision. The specificity of a method defines the level of matrix interference with the analyte, whilst method detectability determines the limit at which an analyte can be detected with confidence and sensitivity is the change in response per unit of analyte concentration. Other criteria which influence the usefulness of a method include ease of operation, large dynamic range, speed and cost, portability and ruggedness.

In addition to using official or validated methods with known accuracy and precision, the analyst must employ a number of quality control actions to optimise data quality. These include the use of accurate and clean glassware, calibrated equipment, pure or standard chemicals and reagents, reagent blanks, recoveries, duplicate (or replicate) analyses and control samples and appropriate reference samples.

Certified biological reference materials.

Certified biological reference materials (RMs) are specially prepared well-characterised homogenous stable food (or other biological) materials containing analytes at certified levels measured by highly accurate methods (Wolf 1985). RMs are used to validate measurement systems and analytical results. Most RMs in common use in food composition work are for inorganic nutrients and the lack of RMs for organic nutrients has been recognised as a severe problem for nutrient analysis.

Statistical control

Overall the analyst must ensure that the methods are always in statistical control. *Until a measurement operation has attained a state of statistical control, it cannot be regarded in any logical sense of measuring anything at all* (Taylor 1987).

In effect this means that in the routine application of the method, the accuracy and the precision of the measurements as described for the method should be maintained at all times. The accuracy of the method is established by determining the difference between the true or known value of the analyte and the measured value. The precision of a method is measured by the standard deviation of a set of results from the mean derived from a number of repeated applications of the method.

A convenient laboratory tool for assessing the performance of the measuring process (method and analyst) is a control chart on which values of control or reference samples analysed over a period of time are recorded (Taylor 1987). By maintaining the control chart in real time, the analyst is able to detect changes in the performance of the method at an early stage. Significant changes in the precision or bias of the process are obvious from eyeballing the chart. Warning limits and control limits based on previously determined precision data are included on the chart to facilitate corrective action. Control charts are not limited to measurements on control and reference samples, but can also be used to monitor the range between duplicate measurements. This is particularly useful when reference samples or suitable controls are unavailable. A range control chart however is limited in that it can only indicate changes in analyst precision as any change in method bias will affect each duplicate result. The control chart illustrates whether the measurements process is in statistical control. As a consequence the analyst can assume confidence in data derived from single determinations. Having established that the analytical process is in control, the analyst derives more useful data from a set number of single determinations than half the set number of duplicate tests, the analytical effort remaining the same. However, this situation is mainly applicable when large numbers of similar samples are being routinely tested.

Application of quality assurance concepts to nutritional analysis

Whilst commitment and adherence to GLP procedures provide the first and most important level of quality assurance, the complexity of nutritional analysis due to the diverse range of foods and the wide range of analytes adds another dimension of difficulty. The limiting factors in assessing a laboratory's performance in Australian nutritional analysis programs include the general unavailability of certified reference food materials and a shortage of suitable collaborative laboratories in Australia. Few (if any) methods employed in nutritional analysis are absolute but generally rely on a comparative measurement between a standard (or reference) substance and the analyte. The unavailability of similar reference substrates increases uncertainties about the accuracy of the measurement. Likewise, whilst within-laboratory or operator precision can be readily determined, the shortage of collaborating laboratories reduces opportunities for comparison of between-laboratory precision.

Conclusion

Because of the diversity of food substrates, the extensive range of analytes involved and the differing stabilities of analytes, in particular vitamins, the application of standard analytical quality assurance procedures in nutritional analysis cannot be fully optimised. There is therefore a greater reliance on the experience and intuition of the analysts, a professional laboratory environment and organisation, effective program management and control, due attention to staff training and continuity of expertise and an appreciation of and commitment to the principles of GLP. In addition there is a greater requirement for analysts to check and evaluate analytical results against published values and to support data with details of sampling, methodology, method precision and quality assurance. Food composition analysis for national food composition tables is and will continue to be a professionally demanding task.

References

Garfield, FM. 1989. Sampling in the analytical scheme. J. Assoc. Off. Anal. Chem. 27: 405–11.

Haddy, B. 1990. Food composition data and the National Heart Foundation's

Food Approval Program. Food Aust. 42:8, s 14–15.

Horwitz, W, Cohen, S, Hankin, L, Krett, J, Perrin, CH & Thornburg, W. 1978. Analytical food chemistry. Inhorn, SL (ed). Quality assurance practices for health laboratories. Washington, DC: American Public Health Association. 545–646.

Scheelings, P. 1987. Food composition analysis—getting started. English, R & Lester, I (eds). Proceedings of the first OCEANIAFOODS conference. Canberra: AGPS. 39–44.

Taylor, JK. 1987. Quality assurance of chemical measurements. Chelsea MI: Lewis Publishers Inc.

Wolf, WR (ed). 1985. Biological reference materials: availability, uses and need for validation of nutrient measurement. New York: John Wiley and Sons.

Compilation and scrutiny of food composition data

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The compilation of food composition data into tables or a data base is a process that begins with defining the aims, objectives and uses of the food composition data base. The result is a specialised, documented data base tailored to meet these defined specifications. Compilation is a complex task involving the collection of data; the commissioning of food analytical programs; the documentation and storage of data for each food from each source; the search for information necessary to compile these individual data appropriately and meaningfully into representative food items; the assembly of these into a data base to produce derived values, documentation and description of items for the user; and the preparation of derived data bases for specific user groups. At every step in this process the data are scrutinised for acceptability against data quality criteria specified for the data base by the compiler (Southgate & Greenfield 1988).

This data scrutiny is itself a process requiring a knowledge of the factors that influence foods and their composition including laboratory procedures and analytical methods, the use of statistical and research techniques as well as data comparison procedures.

This review of the factors considered during data scrutiny and compilation is based on the experience of producing *Composition of foods, Australia* (COFA) (Cashel & others 1989) and NUTTAB89 (Department of Community Services & Health 1989). The programs for these publications have been outlined previously (Cashel 1989, English 1990).

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At the time the Australian food composition program began there were few published data on Australian foods available in the literature. The Australian program was therefore built around a commissioned analytical program aimed at producing, within practical and financial constraints, the most representative data possible. This required particular attention to sampling procedures.

Sampling procedures for representative data

Since the sampling procedure aimed to ensure that the food sample analysed was reasonably representative of the food item available to the consumer for consumption, consideration was given to geographical density of the population, where food is produced and purchased and the factors that might influence the variability of the nutrients in the food, at the time of purchase, and during and after sampling. Many factors influence nutrient content, but not all of these factors apply to all types of food. A flexible system is therefore necessary and for each new food type a specific sampling protocol is developed.

In Australia while regional variation in foods can be expected, sampling across the capital cities of a number of States does not necessarily provide the most appropriate or representative food sample. Many primary products and manufactured foods are produced in a small number of centres and then nationally distributed, and so do not reflect the local growing conditions around each city, eg mangoes and other tropical fruit. Further, nutrient changes may be introduced into fresh produce during packing, storage and transport to the central analysing laboratory resulting in data which do not reflect the nutrient content of foods as purchased by consumers. These and other considerations including budget limitations resulted in much of the sampling being undertaken in the region of the analysing laboratory.

The aim was to obtain a sufficiently wide range of samples from differing batches to obtain a representative nutrient profile for the product. For processed and manufactured foods, where possible, varieties or brands sampled are based on national market shares while for some foods, sampling from different production runs was more important. Samples were purchased from consumer preferred retail outlets by an unidentified purchaser. For some of the fruit and vegetable items these outlets included major markets to obtain exotic produce, to assist with identifying cultivars and to allow sampling from different growing regions. Foods were analysed within their product shelf-life, as defined by use-by-dates. For most foods a composite sample was prepared for analysis from multiple individual samples.

Laboratory programs

Data scrutiny begins back at the laboratory. The demands made from a project of this size and complexity are immense and each laboratory involved has needed 18–24 months to set up methods, solve problems and develop expertise in all aspects of the program. Far more is expected of the laboratory than just analysing a food sample. The laboratory must collect samples to a written protocol and must provide a range of information about the item analysed including purchase date, purchase site, sample descriptions and copies of labels, sample sizes, handling, gross composition, edible portion, analytical sample preparation, weight changes, analytical methods used as well as the nutrient levels determined. The submitted laboratory reports are scrutinised in the Nutrition Section of the Department and queries are referred both to program advisers and back to the laboratories. This may continue for months, even years, and may require re-analysis and sometimes re-sampling to finalise the analytical data.

Factors in data scrutiny

The new data were drawn from the food analytical program, from published articles on Australian foods, from the food industry and from unpublished research. A number of factors, discussed below, determine not only the suitability and usability of the data but also correct interpretation of the data. In addition overseas food composition tables and papers were consulted to provide a global context for data comparison and validation.

The food description is vital information for any user. It must clearly identify the food item analysed and should therefore include an objective identification, ie scientific name, components of mixed foods; physical state, ie raw, cooked or processed; and cooking or processing description. All too often the food descriptor consists of 'mango', 'hamburger', or 'mince meat' and the reader is left to guess the form of the food analysed (raw, canned, dried), the animal (or other) food base of the 'mince meat'; whether the mango was peeled or unpeeled; which components made up the 'hamburger' and, or course, the exact meaning of that useful descriptor 'cooked'. Misuse of such terms can be highly misleading. For example the data for both *battered* and fried oysters and shrimps in Thomas and Corden (1977) are identical to those for *breaded* and fried oysters and shrimps in the 1963 edition of the US tables (USDA 1963). However, not only are the composition of fried *battered* foods and fried *breaded* foods different due to differing proportions of coating to food and to differing fat absorption levels (Makinson & others 1987) but the food called shrimp in the US is commonly called prawn in Australia. The use of the term 'shrimp' in Australia suggests a very different sized unit of food and a different flesh to coating ratio. This kind of factor has to be considered when evaluating data against data from other countries.

If the food is processed, consideration must be given to whether its composition is affected by food legislation which may vary both by State and with time. This information is pertinent not just to the relevance of the data but also to checking the accuracy of the analytical values eg margarines and the meaning of terms such as 'table', 'polyunsaturated'.

The sampling description required includes whether the food was as generally available to consumers; whether the food was selected to specified criteria and, if so, what these were; when and where the food was purchased or obtained; how many samples of what size were obtained, and, if relevant, brand names.

This highly pertinent information assists to identify season, region of origin, market availability, consumer availability as well as nutrient implications. For example, the vitamin C content of a fresh-picked apple analysed immediately is inappropriate to represent the vitamin C content of applies stored for more than three days regardless of whether the apple is retail or home produced. The vitamin C content of a fresh-picked apple falls to a stable level after picking (Wills & El-Ghetany 1986). Data for fresh-picked apples would therefore be misleading if used to represent apples as available to the vast majority of the population. Similarly data from a study of vitamin C in oranges grown on experimental root stocks may be quite inappropriate relative to the commercially available fruit.

Further, without cultivar identification, local data on the potato, for example, would have been difficult to evaluate in a global context.

The edible portion information is vital to knowing to what the analytical data relate. The compiler needs to know which components of the food were included in the analytical sample; which components were rejected; and what the proporations of these were. This information assists both in further identifying the food as purchased and the food as analysed. All too often this information is not given or only the edible portion factor is given, usually as a percentage. The edible portion can at least provide some basis for assessing what proportion and, to a lesser extent, what part of the food is considered as edible. Different cultures may eat different parts of a food and this may change with time. For example, the fibre debate has affected what is commonly considered as 'edible' in our community. Also, the food as purchased may change with time and, without an objective description the edible portion, expressed only as a percentage, will be quite inappropriate and even misleading to the user. For example, fresh carrots used to be marketed in bunches with their tops resulting in a lower edible portion value than that of current market-trimmed carrots. Similarly, for meat chops changes in retail trimming practices affect the proportions of edible flesh to bone in the food as available.

Analytical sample information is required to identify whether a single or composite sample were formed (Greenfield & Southgate 1985) and, if composite, the number of units used and the proportions in which they were combined. The preparation of the analytical sample indicates the approach taken to obtain data representative of the food as purchased.

Laboratory handling and preparation information required by the compiler includes how the food sample was handled and stored both in the laboratory and, if transported significant distances, during transport; how the analytical sample was prepared and stored; and when and in what order the analyses were carried out. Sample handling and storage should be consistent with, at a minimum, usual home practices, ie consistent with manufacturer's instructions and appropriate to the food. If the food was transported, eg from interstate, details of how the food was prepared and packaged and information about the time lag between purchase and laboratory delivery must be available. Obviously some nutrients are affected by these handling practices.

Moisture and vitamin C analyses, in particular, should be performed as soon after receipt of the food as possible. Further, for a food that must undergo significant transport and time delays, weighing of the food at the time of purchase and packaging, and again at the laboratory provides an indication of the degree of physical change in the food. As many foods have a high moisture content small changes can have a large effect on the final expression of the nutrient concentration of a food as originally obtained. For other nutrients, inappropriate handling and storage may produce artifacts in the data resulting in both losses and apparent gains in nutrients. Factors affecting loss of nutrients such as the effect of ultraviolet light on riboflavin levels in milk are well known, but certain preparation and analytical method combinations may also result in apparent gains. The freeze-drying of a high starch food will result in the formation of resistant starch which, when the dietary fibre content is determined by the current AOAC recommended method will give an apparently higher value for total dietary fibre than exists in the fresh food item (Bingham 1987, Englyst & others 1987).

The analytical method used must be valid, appropriate to the food and identify all required components of the nutrient. Analytical technology and associated methods are continually evolving as knowledge improves about the active forms of a nutrient and the specificity with which they can be quantified. For some nutrients, eg dietary fibre, vitamin A, this naturally leads to a healthy debate about the components which should be included in the generic name of the nutrient and their relative physiological activities.

Significant inconsistencies are seen in reported levels of nutrients due to the use of differing analytical methods which vary in the active principles they measure. For example, the method used to analyse vitamin C and accepted for the official US tables measures only ascorbic acid (USDA 1976–1989) while that in the Australian (Cashel & others 1989) and British (Paul & Southgate 1978) tables measures both ascorbic and dehydroascorbic acid. Further, the US food composition tables do not include analytical data for carbohydrate but data calculated ‘by difference’. Most food industry laboratories also prefer the ‘by difference’ method. Such ‘measures’ include dietary fibre as part of the carbohydrate measure and affect the factors used to calculate energy. Carbohydrate and its components may be reported as monosaccharide equivalents (eg Paul & Southgate 1978) or as grams of component (eg Cashel & others 1989). Nutrients determined and methods of expression can vary even within a food composition table, especially when released in a series over a number of years (eg dietary fibre data in both the US tables (USDA 1976–89) and UK tables (Paul & Southgate 1978, Holland & others 1988). For some nutrients eg folate, the debate over the revelance of the data by existing methods makes suspect *all* the available data. For others, eg vitamin A, the new analytical technologies challenge previous assumptions about the isomers being measured and their biological relevance. These factors must all be considered when scrutinising data against comparable foods from elsewhere in the world.

Quality control and mode of expression must also be considered before analytical values, from any laboratory, should be accepted as correct. Data such as range, standard deviation and coefficient of variation must be used with caution as these may relate to biological variability or seasonal variability of the nutrient or to intra- and inter-analyst, laboratory or method variability.

There are internal consistency checks for reliability such as the sum of fatty acids and proximates to assess consistency of relative levels of nutrients in data for the same food. Moisture has already been identified as a critical nutrient in terms of expressed levels of nutrients on a wet weight basis. Apparent differences in data may be due to differing levels of hydration. Moisture too may be the only indicator of a dried or partially dried food. In published data it is also important to check the factors used for determining calculated values, eg nitrogen factors, fat factors, energy factors.

The data source is generally obvious when dealing with analytical research papers and laboratory reports. For data from food composition tables, nutrition texts, consumer reports and food industry information the source may not be clear and yet is critical to interpreting the data and their usefulness. Food industry data are often a combination of limited analyses and values calculated from product formulations. The analytical data may be local or from the parent company overseas. The rest of the data may be derived from any number of sources, the most popular being the previous official Australian tables (Thomas & Corden 1977), the US tables and the UK tables. Many of the food tables of the world, including Thomas and Corden (1977), use or are based on the US tables with or without specific referencing and without adaptation except for changing the food name to the local preferred name. Nutrition texts can use one or more sources, usually a major national table, sometimes with a small proportion of local data and even with selective and arbitrary changes to one or more nutrients (eg Briggs & Wahlqvist 1984).

If sources are not specified the user has no information at all on the reliability of the data, their Australian relevance, the analytical methods used (and thus the components measured) or the currency of the data and cannot go back to the primary source or the analyst for more information. Lack of adequate referencing is a breach of scientific conventions and source acknowledgement and even of copyright. Food composition data are a national and international resource and their integrity needs to be recognised, valued and protected.

Compiling food composition data

The process of compiling food composition data into the data base aims at ensuring internal consistency and compatibility of data and requires the steps described below.

Repeating, extending or rejecting data analyses refers to data needed to provide the minimum range of nutrients necessary for inclusion in the tables and/or for checking on data that the compiler questions as a result of the scrutiny process.

For example, the Australian meat data as published by the researchers (Greenfield 1987) are not necessarily identical to those in COFA. Data from one group could not be used because of uncertainty about the representivity of the meat samples analysed, while fatty acid data from another group were no longer adequate as the capillary gas chromatography technique became preferred. Therefore, a separate program commissioned later determined the fatty acid content of beef by capillary gas chromatography and provided further gross composition and other nutrient data. These data were then combined with the data from the initial program for inclusion in the new tables.

Data may be rejected if the method used was incompatible with the specified or validated methods. For example, the data identified as 'residue' 'fibre' and 'dietary fibre' in the Greenfield and Wills published papers (Greenfield & others 1981, Wills & El-Ghetany 1986) were not included in COFA as the method was not validated. The modified Englyst method (Englyst & others 1982, Jones & others 1985) was initially used in the commissioned Australian program and the AOAC method (Prosky & others 1985) is now used.

These two methods are not compatible and do not measure the same components of dietary fibre. The Englyst method is highly specific and measures chemical defined components of dietary fibre and excludes resistant starch and substances measuring as lignin from its reported total dietary fibre values. The AOAC method provides a measure of total dietary fibre (TDF) that includes resistant starch and lignin. The modification to provide some measure of soluble and insoluble fractions is also used in the Australian program (Prosky & others 1988). The shift from the Englyst to the AOAC method for use in COFA was a pragmatic decision based on factors such as regular availability of analytical resources and the cost of analysis and is regularly reviewed in the light of the current scientific debate.

Levels of significant figures have recognised and recommended conventions for nutrient data presentation (Greenfield & Southgate 1990). Analysts may, however, report data to a higher or lower number of significant figures thus necessitating in some cases the rounding of data for tables. Most computer generated tables, eg the US tables, have a fixed level of reporting with most nutrients at a standard two or three decimal places. The Australian Nutrient Data Bank system specifies a level of reporting for each nutrient at the time of printing but does not yet have the facility to round selectively to the nearest five or ten units, for example.

Calculation factors for generating data on some nutrient components eg energy, or for adjusting to quantity per unit of food using fat and nitrogen factors are generally based on internationally recognised conventions (Paul & Southgate 1978). The literature is monitored as these factors can be affected by developments in analytical methods.

Changes to the food may have occurred since the food item analysed was purchased. For the commissioned Australian programs the delay between the decision to analyse a food and publishing the data should be less than three years but has been up to eight years for COFA. The interval comprises the time needed to research available products and to draw up a sampling protocol (usually, 6–8 weeks); the food analysis program (usually 12 months, especially if foods are seasonal); laboratory checking and reporting (usually 6–12 months); data scrutiny, evaluation and preparation (6–12 months per program); and the publication process (now about 3 months). The article in a scientific journal may be a little younger (date of food sampling should be sought). Even in this relatively short time there may have been changes in a food item due to changes to the fortification formula, ingredients, food legislation, additives (eg β-carotene being used as a food colour), wholesale or retail practices (eg butchering) or agricultural practices (eg preferred carcase composition or major plant cultivar). Such changes must be monitored, and assessed and the data handled accordingly in order to represent the food accurately in the published tables. There may be a need for reanalysis of some nutrients, eg β-carotene, or to modify the way the food is described. For example, an extruded snack product may stay the same in composition but change in size or shape of the pieces or in name and package size of the product.

The best representation of a food in the tables requires considerable thought, discussion and research. The arithmetic mean of all analytical values for a nutrient in one food does not necessarily produce an appropriate representation of the food as available to the consumer. Some of the data may be appropriate to a specific growing region, season, or factory output, or to selected batches of a processed product. Other data may be from a composite of samples more broadly drawn from the food supply. Allowance for these differences may result in weighting the data to allow for such differences or the use of footnotes to highlight specific seasonal or regional differences. Similarly if there are data on individual brands or cultivars of a food these may be weighted on the basis of market share or production ratios. This is usually done if the major basis for identification of the food to the consumer is generic, eg apricot, baked bean, milk coffee biscuits or cheddar cheese. For others, such as apples, both approaches may be taken, ie data provided on individual cultivars (Jonathon, Granny Smith etc) plus generic 'apple' from weighted means of the individual cultivars.

The potential use of the data is considered when making such decisions. For example, a major use of food composition data is in dietary studies where subjects report the foods consumed. The likely ability of the consumer to identify a food (eg by cultivar) at the time of purchase or consumption is considered in presenting data. Also, if a statistical analysis of different data on a range of shaped, sized and branded extruded snack products shows no difference in their analytical values then the inclusion of a generic named item in the food table provides useful and reliable data to users that allows for the cosmetic differences.

Terminology development to describe the foods sampled and the parts actually analysed is a significant aspect of preparing data for users, as is grouping the foods for location and index purposes in tables. The aims are to develop criteria to allocate foods objectively to a grouping; to use terms unambiguously and consistently to describe the food, the edible and inedible parts and the basis of the sampling; to describe the analytical sample; and to describe the analytes and the analytical methods used. Working descriptors and definitions have been developed for these specific purposes in the new Australian food tables and are described and defined in the text.

Gross composition and food measures are critical to providing nutrient information in practical terms for users. Gross composition data, that is, ingredients and proportions of ingredients in mixed foods or components and proportions of edible and inedible parts of fresh or single ingredient foods, are regularly monitored. Changes to these may affect edible portions (eg carrot tops, butchering techniques), nutrient composition (butchering techniques and practices), weight changes associated with cooking and meaningful description of the food as available.

Where possible sampling protocols and the details recorded for food samples anticipate that such changes occur. For example, the muscle tissue and separable fat components were analysed separately for meats and details of the proportions of muscle, separable fat and bone recorded (Greenfield 1987). This allows for representation of meat cuts at different levels of fat trimming and for revision of nutrient data of meat cuts as available retail based on gross composition data, without further expensive analytical work.

Full descriptions and associated weights of measures of foods, particularly standard measures of foods, are part of the food analytical program. Such measures are routinely collected as part of the laboratory reports and a funded three year weight for defined measure program was commissioned to obtain such information (English 1990). Other investigations of these measures from a variety of sources have also been undertaken.

Correct understanding and use of food composition data

It should be clear from this account that compiling national food tables involves more than cataloguing numbers collected through the commissioned analytical programs or other sources and wrapping a cover around them, and that the data provided are not stagnant and unchanging. Modern users are generally far removed from the production and compilation of the basic composition data, and, in addition, the ease of ‘plugging’ into a computer and generating instant analysis of food and diets further seduces their questioning facilities. Users must be prepared to become more knowledgeable by reading the explanatory text acompanying food composition tables or a data base. In addition they must be prepared to become better informed about the background to the production and compilation of food composition data as this will enhance the quality and appropriateness of the uses to which such data are put in the scientific practice of nutrition and dietetics.

References

Bingham S. 1987. Definitions and intakes of dietary fibre. Am. J. Clin. Nutr. 45: 1226–31.

Briggs, D & Wahlqvist, M. 1984. Food facts. Ringwood: Penguin Books Australia Ltd.

Cashel, K. 1989. Australian nutrient data tables. Food Aust. 41: 1034–5.

Cashel, K, English, R. & Lewis, J. 1989. Composition of foods, Australia. Canberra: AGPS.

Commonwealth Department of Community Services & Health. 1989. NUTTAB89. Nutrient data table for use in Australia. Disk format. Canberra: AGPS.

English, R. 1990. Composition of foods, Australia. Food Aust. 42: 8, 55–57.

Englyst, H, Trowell, H, Southgate, DAT & Cummings, J. 1987. Dietary fibre and resistent starch. Am. J. Clin. Nutr. 46: 873–4.

Englyst, H, Wiggins, HS & Cummings, JH. 1982. Determination of the non-starch polysaccharides in plant foods by gas-liquid chromatography of constituent sugars as alditol acetates. Analyst 107: 307–18.

Greenfield, H (ed). 1987. The nutrient composition of Australian meats and poultry. Food Technol. Aust. 39: 181–240.

Greenfield, H, Lee, YH & Wills, RBH. 1981. Composition of foods. 11. Muesli. Food Technol. Aust. 33: 564–8.

Greenfield, H & Southgate, DAT. 1985. A pragmatic approach to the production of good quality food composition data. ASEAN Food J. 1: 47–54.

Greenfield, H & Southgate, DAT. 1990. Guidelines for the production, management and use of food composition data. An INFOODS manual (in press).

Holland, B, Unwin, ID and Buss, DH. 1988. Cereal and cereal products. London: The Royal Society of Chemistry.

Jones, GP, Briggs, DR, Wahlqvist, ML & Flentje, LM. 1985. Dietary fibre content of Australian foods. 1. Potatoes. Food Technol. Aust. 37: 81–3.

Makinson, JH, Greenfield, H, Wong, MI & Wills, RBH. 1987. Fat uptake during deep-fat frying of coated and uncoated foods. J. Food Comp. Anal. 1: 93–101.

Paul, AA & Southgate, DAT. 1978. The composition of foods. London: HMSO.

Prosky, L, Asp, N-G, Furda, 1, De Vries, JW, Schweizer, TF & Harland, BF. 1985. Determination of total dietary fibre in foods and food products: collaborative study. J. Assoc. Off. Anal. Chem. 68: 677–9.

Prosky, L, Asp, N-G, Schweizer, TF, De Vries, JW & Furda, I. 1988. Determination of insoluble, soluble and total dietary fibre in foods and food products: Interlaboratory study. J. Assoc. Off. Anal. Chem. 71: 1017–23.

Southgate, DAT & Greenfield, H. 1988. Guidelines for the production, management and use of food composition data: an Infoods project. Food Sci. Nutr. 42F: 15–23.

Thomas, S & Corden, M. 1977. Metric tables of composition of Australia foods. Canberra: AGPS.

US Department of Agriculture. 1963. Composition of foods. Raw, processed, prepared. Handbook 8. Washington DC: USDA.

US Department of Agriculture. 1976–1989. Composition of foods. Raw, processed, prepared. Handbook 8 series. Washington DC: USDA.

Wills, RBH & El-Ghetany, Y. 1986. Composition of Australian foods. 30. Apples and pears. Food Technol. Aust. 38: 77–82.

Food composition data in the promotion of lean meat in Australia

L. Fantini

Beef and lamb have long played a part in both Australia's rural industry and in the eating habits of Australians. The introduction of cattle and sheep by the first fleet in 1788, the opening of pasture land in western NSW and the success of grazing livestock led to beef and mutton becoming staple items in the diet of early Australians (Symons 1984). In those early years, the relative abundance of meat and its low price could well have created an attitude towards red meat as a favoured food item, an attitude that was to last many years (Clements 1986). Given this attitude, it is not surprising that beef and lamb continue to play a major, albeit less dominant role in the current Australian diet. Until comparatively recently, it was considered unnecessary to spend a great deal of time, effort and money promoting meat to Australians, and until the early 1980s the major role of the Australian Meat and Live-stock Corporation (AMLC), formerly the Australian Meat Board, was to promote the export of Australian meats and livestock.

Changing food preferences

In 1984–5, comprehensive market research (McKinna & others 1984, The Campaign Palace 1985) painted a very dismal picture of Australian consumer attitudes towards beef and lamb. No single factor could be isolated as solely responsible for the move away from red meat, but rather, a number of inter-related factors emerged identifying marketing problems which needed to be overcome, as they added up to a fundamental lack of consumer confidence in the product:

Perception of inconsistency of both price and quality. Common concerns and complaints were quality variation, from week-to-week or retailer-to-retailer, and inexplicable sharp rises and falls in price;

Competitive protein sources. Chicken, fish, vegetarian meals and the Pritikin diet had all infiltrated the Australian diet;

Trading hours. The inability to purchase red meat during all normal retail trading hours in most States was cited as a major disadvantage, particularly by working women, whereas competitive protein foods such as chicken and fish could always be readily purchased;

Lack of convenience. Consumers regarded red meat as messy and time-consuming to prepare. It did not meet the needs of working women who preferred quick, convenient foods which reduced time and effort in the kitchen;

Poor merchandising. By comparison with most other food categories there was nothing new happening in the area of retail presentation;

Nutrition. Concern was expressed about nutritional aspects, ie excessive fat, cholesterol, kilojoules, and the vague and undefined feeling that “too much red meat isn't good for you”;

Ethnic foods. Fashion in food was being created by a surge of new restaurants featuring different, exciting and varied cuisines, very few of which included red meat;

Lifestyle changes. Red meat was not seen as contemporary or fitting into the modern lifestyle. The traditional family Sunday dinner of roast and three

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vegetables was no longer appropriate as meals were often served on the run;

Lighter meals. Red meat was seen, particularly by women, as too heavy and indigestible in contrast to the many light alternatives available;

Lack of variety. The product was seen as lacking in variety, with very little novelty; in short, dull and boring.

A number of marketing strategies were undertaken to counteract these problems, particularly in the area of advertising and merchandising, but effective response to the nutrition controversy was hampered by a lack of up-to-date data on the fat and cholesterol content of meat. In addition, the only data on the fat contribution made by meat to the diet was apparent consumption data (ABS 1986). This indicated that meat as available provided around 37% of the fat in the diet. In reality, meat as consumed contributed much less. This is because apparent consumption statistics generally overestimate fat contribution by not taking into account the loss of fat from the carcase during the preparation of retail cuts (Fantini & MacDonald 1987). Media reports on health and popular nutrition paperbacks (mainly based on US meat data) created a perception of beef and lamb as less than optimal protein sources for today's consumer. This perception was equally common amongst health professionals, as evidenced by the fact that only recently was “chicken (no skin)” incorporated as standard advice into nutrition education materials produced by an independent health authority (Australian Nutrition Foundation 1989). Until now, the advice has been “lean meat, poultry, fish”, incorrectly indicating that poultry was already lean and thus acceptable.

The industry was aware that the unwarranted criticism of the fat and cholesterol content of beef and lamb came from a lack of knowledge of Australian meat composition and its production, such as: that meat composition (in terms of fat and cholesterol) could vary from country to country; that Australia's meat production techniques (essentially pasturerearing) generally favoured the production of lean, non-marbled meats; that grain-feeding or lot-feeding is not as extensively used in Australia as it is in the USA, and as a result marbling is practically non-existent in Australian beef as compared to US beef; and, that improvements had been made by the industry, such as the introduction in the 1960s and 70s of European breeds which favoured carcases of a lower total fat cover.

The employment of dietitians by the AMLC in 1984–5 was seen by the industry as a vital step towards the dissemination of accurate nutrition information on beef and lamb. Therefore, the attainment of up-to-date data on the composition of beef and lamb became the first priority.

Meat composition data

The existing official food composition tables for Australia (Thomas & Corden 1977) did not reflect the meats Australians were consuming in the 1980s but were based on British, American and/or 40-year-old Australian data. The out-of-date and non-applicable data contributed to the strong perception that red meat consumption meant a high fat intake and therefore a high health risk, whereas white meat (eg fish or chicken) was nutritionally more desirable (Chris Adams Research 1986).

Despite the concern regarding the nutrient composition of red meat and its effects on the nutrient intake of Australians, no new data became available until the mid 1980s. The first available data came from the work of Sinclair and O'Dea (1987). Their final report to the Australian Meat Research Committee in 1986 (subsequently published in 1987) showed that the average lean intramuscular fat content of beef cuts was 3.1%, with a range from 1% to 11% over 460 samples. Lean lamb intramuscular fat content was around 4.6% on average with a range of 2.6% to 12.3% over 36 samples. These figures were lower than those published in the existing official food tables (Thomas & Corden 1977) for lean boneless beef (6.6%) and lean boneless lamb (6.3%). The work of Sinclair & O'Dea (1987) was also the first to supply information on the fatty acid profile of lean meats. There had been a strong perception that not only was red meat high in fat but it was also high in saturated fat with little or no polyunsaturated or monosaturated fatty acids present. Their results showed that lean beef contained major amounts of oleic acid, a monounsaturated fatty acid (27–44% of total fatty acids) and significant amounts of the polyunsaturated fatty acids, linoleic, linolenic and arachidonic.

Sinclair and O'Dea (1987) also revealed little or no difference in the intramuscular fat content of grain-vs grassfed beef, even when comparing carcases of two different fat cover depths. This work indicated that unless significant marbling was present, the grain-fed beef generally available on the Australian domestic market was similar in fat content (around 4%) to pasture fed meats, once selvedge fat was removed. This contrasts sharply with US grain-fed beef which has a minimum fat content of 9%.

This work was supplemented by research conducted at CSIRO by Thornton and co-workers (1987) who examined the fat content of popular cuts of meat, raw and cooked, including T-bone, rump, blade and topside, lamb loin chops, rolled lamb shoulder roasts, as well as fresh and frozen chickens, whole and as chicken pieces. These results showed that some portions of chicken were higher in fat relative to beef or lamb, even after the removal of chicken skin. It was clear that only skinless chicken breast at 3% fat (raw) was lower in fat than the four beef cuts examined. Therefore, lean beef and lamb, trimmed of visible fat, could not be condemned as high fat foods.

These initial results from separate research groups considerably aided the AMLC in promoting the nutritional benefits of beef and lamb in a more specific manner. However, the AMLC refrained from any major advertising activities as release of official research on the nutrient composition of meats was imminent. These data were to further consolidate the findings of Sinclair and O'Dea (1987) and Thornton and co-workers (1987).

The publication of those official data from the work of Greenfield, Truswell and co-workers on the composition of Australian meats and poultry (Greenfield 1987) allowed the AMLC to implement its marketing activities fully promoting the nutritional benefits of beef and lamb. These data and the newly revised and released official food composition tables (Cashel & others 1989) form the basis for all current activities of the AMLC in the promotion of the nutritional benefits of beef and lamb.

Recently, further analytical work by the Australian Government Analytical Laboratories (AGAL) in Adelaide was carried out in conjunction with AMLC participation in the National Heart Foundation's Food Approval Program. Results indicated that all cuts submitted satisfied the NHF's guideline of less than 10% fat. Cholesterol and fat data were similar to those of Greenfield, Truswell and co-workers (Greenfield 1987). These data add further weight to the argument that lean meat, trimmed of visible fat, is a low fat food.

Advertising using meat composition data

The AMLC's concept of “lean meat” is a central marketing tool in the promotion of beef and lamb in the 1980s and 90s. “Lean meat” is readily identified by consumers as “new meat” (AMLC 1988a) and thus meets their needs for convenience, variety, and lighter, more nutritious meals, in contrast to “old meat” which is fatty and lacking in variety.

Over the past four years there has been a meat retail revolution in Australia. Today, meat in butcher shops and supermarkets is different, ie it is leaner, often pre-prepared, and visually stimulating. This is partly the result of a single-minded marketing and advertising strategy called *Short Cuts* focused on quick, easy-to-prepare, nutritious whole meat meals complete with vegetables and cereals. The advertising and merchandising campaign established lean meat as the hero for the busy working woman looking for a solution to the evening meal dilemma. In 1988–89 the *Short Cuts* proposition was expanded to include more traditional meals but with a modern touch. These are the *Today's Steak* and *Lamb Roast* campaigns. Again, the feature is lean meat in complete meals, eg lean steaks and lean roasts. In its mainstream advertising the AMLC was already concerned with promoting lean meat and had spent a great deal of time, effort and money establishing in consumers' minds that beef and lamb, trimmed of fat, were nutritious and convenient, fulfilling a contemporary need for modern women.

The release of the publication *The nutrient composition of Australian meats and poultry* (Greenfield 1987) heralded the start of a new and aggressive campaign to re-position lean beef as a low-fat food with a deserved place in the Australian diet. Three TV commercials were created in the 12 months following the release of the publication: *Weigh Out, Pasta and Potatoes* and *Jane Flemming.*

The first, *Weigh Out*, comparing a lean beef meal with a roast chicken meal stirred much passion amongst health professionals and stimulated consumers to seek much needed information. As previously discussed, the perception of beef (and consequently lamb) being unhealthy was rife in the early 1980s. Market research (Chris Adams Research 1986) had indicated that consumer perception of chicken as a healthy food was all embracing. It was seen as nutritionally superior to beef, and by consequence, lamb. While Australians were acquiring the habit of fat-trimming beef (having associated beef with a high fat, high cholesterol diet) substantially fewer people understood that chicken with skin was also a culprit in a high fat diet. In fact the 1983 dietary survey of adults (Cashel & others 1986) indicated that removing beef fat was more common amongst respondents (70%) than removing chicken skin (30%). Further, having positioned lean meat as its central marketing tool, the AMLC could not logically use anything other than lean meat depicted as fully trimmed of fat, in its new phase of nutrition advertising, using the new meat composition data.

Advertising, if it is to be successful must evoke emotion. It is not truly designed to be educational. While *Weigh Out* was indeed based on facts, the real success of the commercial lay in the emotional response from consumers and health professionals alike, it challenged people's established beliefs. It was designed to make people search out more information. Nutrition education is complex, but advertising must encapsulate a single idea in a 30-second message. That single idea was that chicken, in its commonly consumed form (with skin), contained more fat and cholesterol than consumers may have thought and is no magic food. The commercial also established the idea that lean beef is not fatty and full of cholesterol but instead compared well to the consumer's benchmark of a low-fat protein food, chicken. As a result of the debate which raged after the commercial's airing, consumers now understand that eating chicken with skin is nutritionally no better than eating red meat with the fat.

The *Pasta and Potatoes* and *Jane Flemming* commercials, whilst less controversial, also relied on new meat composition data for the claims for fat, iron and vitamins.

The current food tables (Cashel & others 1989) and NUTTAB (Commonwealth Department of Health & Community Services 1989) depict four levels of trim for beef, lamb and pork: lean only, 75% trimmed, 50% trimmed and as purchased (ie with all fat as purchased at retail). The AMLC on the other hand, in its advertising and general promotional activities, uses lean only data primarily. Health professionals should be aware that the levels of trim indicated in the tables have been arbitrarily selected by nutritionists within the Department as representing current levels of fat trimming by Australians. Health professionals should also be aware that the compositional data for these levels of trim are derived by calculation and not by analysis. Several studies (Cashel & others 1986, Worsley & Crawford 1985) have now indicated that fat-trimming of meat is standard practice, although none of these studies have quantified the amount of fat trimmed. The AMLC believes that consumers understand the concept of lean meat as being trimmed of all visible fat.

In addition, these arbitrary trim levels are dependent on the amount of fat originally present on the cut when purchased. Thus, traditional lamb cuts, usually purchased with all fat attached since some states regulate to prevent the removal of the lamb pink branding at point of sale, are considerably higher in fat content at the 75% trim and 50% trim levels than beef, yet lean only data for fat content of beef and lamb are not dissimilar.

The effect of plate waste (more fat trimming on the plate) must also be considered for lamb in particular. This aberration should be taken into account when these tables and the NUTTAB data base are used by health professionals.

Nutrition education using meat composition data

Many other important and ongoing educational activities of the AMLC also rely on the new compositional data, and aim to cement these nutritional facts in the minds of consumers and health professionals alike.

In 1985, the AMLC entered its new phase of nutrition education. Materials were of a general nature, positioning lean beef and lamb as important components of a balanced diet and incorporating the general dietary advice of less fat, more fibre. However, the release of the revised meat composition data enabled such material to contain more specific information on beef and lamb, and their contribution to the Australian diet.

The AMLC's *Meat, the facts* brochure (AMLC 1988b) is a good example. A publication of this type could not have been produced three or four years ago, as official meat data were not then available. Recently, the AMLC has undertaken the *Meat, the facts* program for general practitioners to give them accurate information on the fat and cholesterol content of beef and lamb while reminding them of the iron, zinc, protein and B vitamins provided by these foods. This activity has included general mailing of materials to GPs, seminars in major capital cities on the nutritional facts about meat, and the production of medical press advertisements. Revised meat composition data as well as the release of the reports from the dietary survey (Cashel & others 1986, English & others 1987) have been crucial to this activity.

Other AMLC activities relying on these composition data include the calculation of fat and energy in recipes specifically designed for the health conscious, as in the AMLC's *Healthy food for healthy hearts* booklet (AMLC 1988c) and in the slimmers section of the new *Short Cuts 2* cookbook (Murdoch Magazines/AMLC 1989). Further, AMLC's participation in the Australian Nutrition Foundation's *Nutrition Time 89* program featured editorial copy based on lean lamb composition data. Similarly, participation in the National Heart Foundation's Food Approval Program (Haddy 1990) has only been possible because of the knowledge of the fat content of lean, trimmed meat.

Conclusion

It is clear that the AMLC's promotional activities for beef and lamb rely heavily on new meat composition data. The AMLC has been single-minded in its depiction, both visually and in print, of lean meat as a central marketing concept. The release of these new food tables should further assist both the food industry and health professionals to get information about food to consumers. However, care needs to be taken by health professionals in the interpretation and use of meat data as presented in the new food tables.

References

Australian Bureau of Statistics. 1986. Apparent consumption of foodstuffs and nutrients. Australia, 1984–85. Catalogue No. 4306.0. Canberra: ABS.

Australian Meat & Live-stock Corporation. 1988a. Meat marketing trends. Sydney: AMLC.

Australian Meat & Live-stock Corporation. 1988b. Meat, the facts. Sydney: AMLC.

Australian Meat & Live-stock Corporation. 1988c. Healthy food for healthy hearts. Sydney: AMLC.

Australian Nutrition Foundation. 1989. Nutrition Time. Sydney: ANF.

Cashel, K, English, R, Bennett, S, Berzins, J, Brown, G & Magnus, P. 1986. National dietary survey of adults: 1983. No. 1. Foods consumed. Canberra: AGPS.

Cashel, K, English, R & Lewis, J. 1989. Composition of foods, Australia. Canberra: AGPS.

Chris Adams Research Pty Ltd. 1986. Evaluation of the short cuts campaign and its effect on consumer attitudes towards red meat. Sydney. Unpublished report.

Clements, FW. 1986. A history of human nutrition in Australia. Melbourne: Longman Cheshire Pty Ltd.

Commonwealth Department of Community Services & Health. 1989. NUTTAB89. Nutrient data table for use in Australia. Disk format. Canberra: AGPS.

English, R, Cashel, K, Bennett, S, Berzins, J, Water, A-M & Magnus, P. 1987. National dietary survey of adults: 1983. No. 2. Nutrient intakes. Canberra: AGPS.

Fantini, L & Macdonald, N. 1987. Trends in meat consumption in Australia 1938–

39 to 1983–84. Food Technol. Aust. 39, 187–190.

Greenfield, H (ed). 1987. The nutrient composition of Australian meats and poultry. Food Technol. Aust. 39: 181–240.

Haddy, B. 1990. Food composition data and the National Heart Foundation's McKinna, D. *et al.* Pty Ltd. and Beveridge & Cummings Pty Ltd. 1984. A quantitative assessment of consumer attitudes, opinions and behaviour with regard to red meat compared with other protein rich foods. Melbourne. Unpublished Report.

Murdoch Magazines Pty Ltd/Australian Meat & Live-stock Corporation. 1989. Short Cuts 2. Sydney: AMLC.

Sinclair, AJ & O'Dea, K. 1987. The lipid levels and fatty acid compositions of the lean portions of Australian beef and lamb. Food Technol. Aust. 39: 228–31.

Symons, M. 1984. One continuous picnic. A history of eating in Australia. Ringwood: Penguin Books Australia Ltd.

Food Approval Program. Food Aust. 42:8, 514–15.

McKinna, D. *et al.* Pty Ltd. 1984. Consumer attitudes, opinions, perceptions and usage of red meat — an exploratory study with particular emphasis on beef. Melbourne. Unpublished report.

The Campaign Palace. 1985. How to sell more meat by using *Short Cuts.* Sydney. Unpublished report.

Thomas, S & Corden, M. 1977. Metric tables of composition of Australian foods. Canberra: AGPS.

Thornton, RF, Tume, RK, Larsen, TW, Johnson, GW and Sexton, WR. 1987. Fat content of popular cuts of meat: Cooked and raw. CSIRO Food Res. Q. 47: 30–7.

Worsley, A & Crawford, D. 1985. Awareness and compliance with Australian Dietary Guidelines: a descriptive study of Melbourne residents. Nutr. Res 5: 1291–308.

Food composition data in the promotion of canned foods

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The Canned Food Information Service Inc (CFIS Inc) is an organisation promoting Australian food packaged in steel cans. Through general publicity CFIS Inc aims: to convince consumers and potential consumers of Australian canned food of the merits of this food delivery system and the foods contained, and to dispel misconceptions and so generate increased purchases; to ensure that Australian canned foods remain a regular ingredient in meals rather than an occasional or standby food; and, to influence those canning companies responsible for the choice of future packaging direction in order to create a climate of greater confidence in the future of the steel can.

The CFIS Inc nutrition education program is aimed at increasing the awareness of the influencers of public opinion particularly health professionals and media writers. Canned food has an image problem with both the public and health professionals. A market research survey conducted by the fruit canning industry in 1987 was undertaken to evaluate the attitude of consumers to canned fruit. Two of the key finding were: nutritional balance is important, some canned food is permissible but canned fruits are not very important in many households because they do not connote fresh fruit taste or nutrition to the majority; and, fresh fruit is an important part of almost every household's diet from the nutrition point of view, but it is difficult to select food pieces and as a result fruit is frequently disappointing.

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More recently the industry conducted another survey amongst 601 grocery buyers. There were many contradictions in the attitudes of consumers to canned foods particularly what constitutes typical buying patterns. The researchers concluded that canned food is a product category with wide utility, yet one with which few people wish to be associated. The underlying basis for this negativity is concern with nutritional aspects of the product. They found that: the more health/nutrition conscious a person, the more negative he or she was likely to be to canned food; generally younger people were more health and nutrition conscious; and, younger people were correspondingly more negative to canned food, particularly 16–24 year olds.

Similar attitudes exist amongst health professionals, eg the *Target on healthy eating* which has been used by a number of State Health Commissions in public education programs places canned food generally among the fair choices rather than excellent choices.

Examination of the nutrient composition of canned and, where possible, equivalent fresh food would answer the question of whether these attitudes were justified. Unfortunately at the time these market research studies were undertaken there were very few hard analytical data available on the composition of Australian canned foods in comparison with other available foods.

Nutritional value of canned foods — Study I

In 1988 CFIS Inc commissioned a study to examine the nutrient content of six products, including both fruit and vegetables. The analyses were carried out by the Australian Government Analytical Laboratory, South Australia, a NATA registered laboratory.

Methods

This study aimed to compare the nutrient content of food as consumed after undergoing different preparation and processing methods.

Products tested were: pineapple (canned in juice and syrup, and fresh); corn niblets (canned, fresh and frozen); tomatoes (canned and fresh); peaches (canned in natural juice and fresh); orange juice (canned and fresh); pears (canned in natural juice and fresh). Because results applicable to the real world were wanted, the products tested were those available on the market at the time of the study. There was no attempt to match cultivars if this required acquiring samples not available on the retail market at the time. Samples of each product were purchased from six different retail outlets in Adelaide suburbs. The six outlets included three supermarkets, these locations being selected to provide a balance between lower and higher levels on the socio-economic scale. Fresh produce generally was of the cultivars most commonly on sale during January and February. All fruit and vegetables were in good condition and of a ripeness ready for use. The canned products included the major brands available on the Adelaide retail market and were all Australian grown and produced. Generic labelled products were not used.

Composite samples were prepared from equal weights of each can sub-sample after homogenisation. The samples of canned products were prepared using the whole can contents. The fresh food was cooked by the methods considered most commonly employed using measured quantities of sugar and salt to taste as appropriate. The canned products were cooked by heating half the composite sample to 90°C, holding for one minute then cooling. This process was chosen since canned food is already cooked during processing.

In general, standard methods of the American Association of Official Analytical Chemists (AOAC 1984) were used, and full details including modifications to methods appear in the report (CFIS 1988). Riboflavin and thiamin were determined by HPLC using fluorescence detection (Wimalasiri & Wills 1985). Carotenes were determined by reverse phase HPLC after hydrolysis and solvent extraction. Minerals were determined by atomic absorption spectrophotometry of an acid solution following a dry or wet ashing.

Results

Table 1 derived from the study report (CFIS 1988) illustrates the comparison between fresh, fresh cooked, canned, and canned heated peaches.

The moisture levels decreased on cooking, the solids increasing proportionally accounting for the increased energy (kJ) level on cooking and heating. Fat, protein and ash did not differ significantly across all peach products tested. Vitamin C, thiamin, riboflavin and α-carotene were all at similar levels in fresh and canned peaches and both cooked and heated, respectively. β-carotene in both canned and canned heated peaches was comparable with fresh peaches.

In general, there were very few significant differences in nutrient content between fresh, fresh cooked and canned and canned heated products studied. Often the differences that did exist were within the experimental error of the methods used. The exceptions were vitamin C which is heat sensitive, sodium which was added at different levels and nutrients affected by cultivar differences.

Communication to the public

It is notoriously difficult to communicate complex scientific information to the public. So that the information is not distorted, it is important that the message contain a single idea and is expressed simply. The findings from this first study were summarised in the statement that: *There were no practical differences between fresh and canned foods in most of the nutrients studied. Even vitamin C was not lost on canning to the extent expected by many people.*

Press releases were written around this single message and interest from the media was encouraging. During interviews with the media it was possible to move on from that simple statement to explain more aspects of food processing and its impact on the nutritional value of foods.

Nutritional value of canned food — Study 2

In 1989 CFIS Inc commissioned a second study to examine a range of prepared canned foods. Many of these products have an identity in their own right and are not readily compared with home cooked equivalents.

Methods

The Australian canned products tested in this program were: soups: tomato (regular and salt reduced), creamy chicken (regular and salt reduced), cream of pumpkin; entrees: baked beans (regular and salt reduced), spaghetti in tomato sauce with cheese, braised steak and onions; baby food: mixed vegetables (canned), berry flavour yoghurt (canned), fruit of the forest (refrigerated yoghurt). Homemade recipes of pumpkin soup and spaghetti in tomato sauce with cheese were also included.

Because results applicable to the real world were wanted, the products tested were those available on the market at the time of the study. Samples of each product were purchased from different retail outlets in Adelaide suburbs. The canned products purchased included the major brands on the Adelaide retail market and were all Australian produced. The canned products were all prepared according to the directions on the label. Soups were diluted with half milk and half water and heated. The recipes for home made soup and entree were obtained from standard Australian home economics texts.

Moisture and sodium determinations were done on regular and salt-reduced varieties before making composite samples. The composite samples each contained equal weights of each sub-samples after homogenisation. Total can contents were used. As in the first study, AOAC methods of analysis were generally used (CFIS 1988).

Results

The tabulated results which are available (CFIS 1989), cover proximates, carbohydrates, minerals, vitamins and fatty acid profiles. The results also expressed the nutrients in a defined serving size of the product. The serving size has been determined from the labels or from knowledge of current usage. Because each product forms part of a single meal, the amount of each nutrient in the serving size has been compared with the recommended dietary intake for women 19–54 years, men 19–64 years and infants of 6 months of age.

The results showed that each product has specific strengths and to assess the value of these strengths, and express them in a more positive way, a range of criteria were chosen.

The Foods Standard Code of the National Health & Medical Research Council has set limits on the nutritional claims which can be made about particular foods, and a reference quantity of the food must contain a defined portion of the daily allowance of that nutrient. The daily allowances have been derived from the RDIs (National Health and Medical Research Council 1986). In summary the code provisions are: a food may claim the presence of vitamins or minerals if the reference quantity contains one-sixth (16.6%) to one-half (50%) of the daily allowance; a food may claim to be a good source of vitamins or minerals if the reference quantity contains not less than one-half (50%) of the daily allowance; and, a food may claim to be of value in the prevention or cure of disease due to the lack of a vitamin or mineral if the reference quantity contains not less than 100% of the daily allowance.

An alternative criterion is the use of the Nutritional Index (NI). This is an expression of the relative contribution to the RDI of nutrients in a food compared with the contribution of energy value of the food to the energy RDI. People understand the concept of "value for money" and this is similar being nutrient "value for kilojoules".

$$\mathrm{NI} = \frac{\dfrac{\text{Mass of nutrient in food}}{\text{RDI for nutrient}}}{\dfrac{\text{Energy in food portion}}{\text{Energy RDI}}}$$

The ratio of the percent nutrient contribution to RDI in the serving size to the percent of energy to RDI in the serving is the NI. Where NI > 1 this indicates a higher nutrient contribution than energy contribution of the food in the diet. In Figure 1 the height of the bars for nutrients which are higher than the energy bar indicates NI > 1 and that the food is a useful source of these nutrients.

The Australian dietary guidelines (Commonwealth Department of Health 1981) include the recommendation that the total fat in the diet should be reduced to less than 35% energy. Where NI < 1 for fat this indicates that the food will assist in meeting that goal.

Using these criteria this second study has been able to demonstrate that the canned foods studied make a significant contribution to the RDI of nutrients for adults including young people. Where canned products have been compared with a home cooked equivalent, the differences in composition reflect differences in the recipes rather than differences due to processing.

Table 1. Proximate and vitamin composition of peaches (per 100g)

Nutrient	Fresh	Fresh cooked	Canned in juice	Canned heated
Moisture (g)	87.0	85.5	85.7	84.4
Fat (g)	0.1	0.2	0.1	0.4
Protein (g)	0.7	0.6	0.6	0.7
Ash (g)	0.4	0.4	0.4	0.4
Energy (kJ)	170	188	177	231
Vitamin C (mg)	5.0	5.0	4.0	5.0
α-carotene (μg)	ND*	ND	TR‡	6
β-carotene(μg)	97	32	89	111

* ND = Not detected
‡ TR = Trace

Promotional message concerning canned foods

The example for baked beans (Figure 1) can be explained in terms of the range of criteria described above. Thus a typical statement for canned baked beans is: *Canned baked beans fit well into the Australian dietary guidelines, they are low in fat, sugar and cholesterol-free. A 125 g serving could claim the presence of fibre and iron and by Nutritional Index criteria is a useful source of protein, complex carbohydrate, potassium, calcium, magnesium, zinc, and thiamin. Reduced salt varieties are also available.*

Similar statements can be made about the strengths of all the products tested, ie: soups, entrees and baby foods. Although according to Food Standards Code criteria, claims about the nutrients in these products cannot be legally made, these criteria are useful in illustrating the strength of canned foods. Viewing the nutrients according to the Nutritional Index offers further evidence of the benefits which canned foods can play in a healthy diet. Thus looking at the nutrient profile of a food is more useful than focusing on particular nutrients in isolation.

Communication of results to the public

The scientific information involved in these results is more complex than that involved in the first study. It involves the need to communicate that different products have different strengths whether they are processed or home cooked. In order to communicate this idea, visual bar charts showing a profile of the food are more meaningful than plain figures. It is also possible not only to compare individual foods but to superimpose the food profile so that a combination could illustrate all of the nutrients required. This idea still remains to be tested in the public arena.

References

Association of Official Analytical Chemists. 1984. Official methods of analysis. 14th ed. Washington DC: Association of Official Analytical Chemist.

Canned Food Information Service Inc. 1988. Residual nutritional value (RNVI). Research and summary report. *

Canned Food Information Service Inc. 1989. Nutritional value research (NVR2). Research and summary report.*

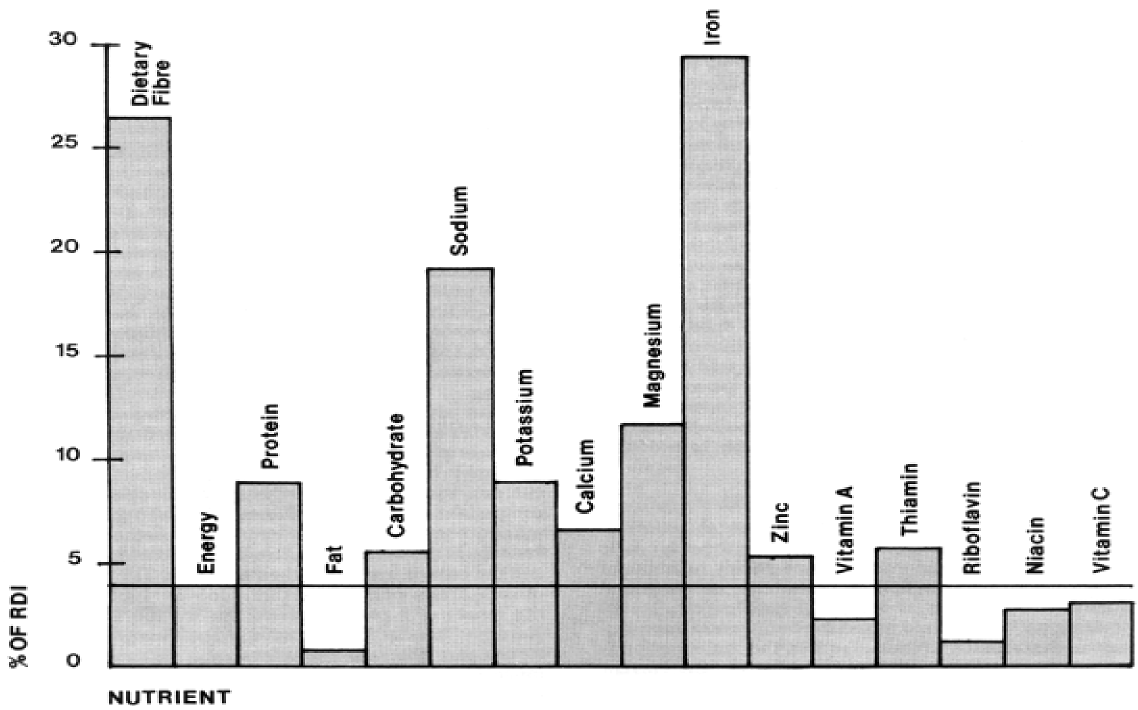
Commonwealth Department of Health. 1981. Dietary guidelines for Australians. J. Food Nutr. 38: 111–9.

National Health & Medical Research Council. 1986. Recommended dietary intakes for use in Australia. Canberra: AGPS.

National Health & Medical Research Council. 1987. Food Standards Code. Canberra: AGPS.

Wimalasiri, P. & Wills, R.B.H. 1985. Simultaneous analysis of thiamin and riboflavin in foods by high-performance liquid chromatography. J. Chromatogr. 38: 412–6.

** Copies a2vailable on request from Canned Food Information Service Inc. 130 Park Street, South Melbourne VIC 3205.*



30
25
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% OF RDI
NUTRIENT
Dietary Fibre
Energy
Protein
Fat
Carbohydrate
Sodium
Potassium
Calcium
Magnesium
Iron
Zinc
Vitamin A
Thiamin
Riboflavin
Niacin
Vitamin C

Development of a special purpose food composition data base for industry

J.A. Barnes

The 1980s have seen an ever growing emphasis on food and nutrition. National nutrition policies have been formulated, health education programs with major food components have proliferated, the media are full of nutrition information and misinformation, and nutrition is increasingly becoming an area of concern to the Australian consumer. As a result the demand for access to accurate detailed nutritional information about the Australian food supply has escalated.

The demand for the information has been formalised as food legislation requires full ingredient listing on packages and nutritional labelling to justify any nutritional claim made on packaging or advertising. Requests to extend the labelling requirements range from the anxious consumer, concerned about the quality of manufactured foods, to health authorities who believe that full access to nutrient information will enable consumers to make more informed decisions and thus select a more appropriate balanced diet.

The penalties for not providing the labelling information required, or for providing incorrect information, can be so costly that reputable manufacturers go to great lengths to ensure that the required information is provided and is accurate. Indeed, manufacturers often go beyond the formal requirements, answering enquiries from the general public, consumer groups, health professionals and government bodies regarding specific aspects of their products.

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To service such enquiries more effectively, one major manufacturing company initiated a project to make nutrition and ingredient information on its food products readily available to the public. This involved the production of a nutritional information booklet generated from product formulas and calculated by means of a modified nutritional computation program. The problems encountered in this exercise, which required close collaboration with the suppliers of the program, form the basis of this paper.

Project options

There were two options available to generate the information, ie analysis or calculation. Considering the magnitude of the project (250 foods), analysis was quickly ruled out as raising too many complex issues such as sampling and analytical methodology, collection of samples from manufacturing outlets scattered round the country and interpretation of the laboratory results. Further, the cost of performing analyses would have been prohibitive. On current commercial prices, simple proximate analysis, plus analysis of sodium and potassium would cost about $200 per food if carbohydrate were calculated by difference. A more comprehensive analysis, including full fatty acid, vitamin and mineral determinations would increase the costs to between $700–$1,000 per food. The number of samples required to obtain a meaningful figure to account for seasonal variations in all the ingredients and the differences which inevitably arise in the manufacturing process meant that a project based on analysis would also not meet other needs, discussed later. It was therefore rejected as a viable option for the project. Calculation of the data from ingredient information was the other option and this option was selected as being both cost-effective and flexible as described later. It was decided to produce the information brochure by computerised recipe calculation similar to the approach of Marsh (1983).

Calculation systems

In a comparison of available calculation methods (Marsh 1983), particular attention was paid to the variations found in the results due to the different retention and yield factors built into the various programs to account for nutrient changes and losses during the cooking processes. No one method of calculation was found to be superior. Indeed the manipulations involved to account for retention and yield factors were considered too complicated to incorporate into a program which would have multiple users. Marsh's recommendation (1983) was to use a simple summation method, ie addition of all ingredient nutrients, with a basic computation built in to account for water losses during cooking.

To investigate the reasons for differing computation results, Frank and co-workers in 1984 had analysed eight representative 24 hour dietary recalls, using two similar software programs containing the same basic USDA nutrient data base extended by the individual operators. This comparison found major differences between the calculated nutrient intakes. The major contributor to the diversity in results was the differing sources of additional nutrient data and the criteria applied to their selection. Taking this kind of comparison one step further, Hoover (1983), reported the results of a project carried out for the US National Nutrient Data Bank Conference series. This project set out to compare the nutrient information generated from a range of computer programs. Proximate nutrients were found to vary by between 11% to 25% of their respective means when results were compared between eight systems. Quality control protocols were introduced to eliminate coding judgements relative to portion size and selection of food items. However, variation between computerised calculation systems remained high. Differences in the nutrient data between data bases were considered to be a source of the variability in the final calculations produced in the study.

A model to review nutrient data base capabilities was subsequently developed (Hoover & Perloff 1983) and this comprised several computing tasks. One task was to verify the accuracy of entry of data for additional food items into the data base; another task was to check the accuracy of calculation of a recipe comprised of nine ingredients. A test of the review model showed that the recipe calculation task produced the greater variability, the final protein composition of the recipe varying from 9.1 to 12.7 g per 100 g. The variability was mainly attributed to differences in the nutrient data in the data bases and to differences in the yield factors used. In a later specific study of data base development, Shanklin and co-workers (1985) again identified data base entries as the cause of analysis variation between programs. More recently Powers and Hoover (1989) evaluated various calculation software programs. These workers acknowledged the shortcomings of the summation method, but their comparison did not enable them to identify and recommend a superior method of computation.

All the available nutrient computation computer programs in Australia are based on the summation principal, so selection of the program depended on its capacity to fulfil other user needs of the client.

Additional criteria for selection of data base computation program

The other requirements considered during the selection of a suitable data base and analysis program for the project were: ease of update when changes occurred in ingredients or formulations; ability to handle new product work particularly in the development of food items to meet specific nutrient guidelines, eg the National Heart Foundation's Food Approval Program (Haddy 1990); formulation of specialised food products; tool in quality control procedures; and, facility to enable the identification of the presence of specific ingredients, eg presence of salicylates or MSG in the food.

The first four requirements would be met using an appropriate calculation type system. To fulfil the fifth criterion a program was required which had the flexibility to extend the fields of the data base by at least nine. Then every food item listed could be coded for the presence or absence of particular ingredients or compounds, such as wheat, egg, milk protein, salicylate etc. When a product recipe was finally calculated a positive listing of all these specific ingredients could be produced.

Package and nutrient data base

The program selected (Diet 1, Xyris Software) was specifically modified both to accommodate the extra data base fields needed and to incorporate an additional calculation option which would extend the range of foods in the nutrient data base, which was NUTTAB87 (Common-wealth Department of Community Services & Health 1987). This data base contains a mixture of both cooked and uncooked foods and as it was primarily developed to be a tool for analysis of diets as consumed, many basic uncooked foods, for which recent Australian nutrient data have been published were not included. Only about 35% of the ingredients used in the manufactured products could be located in the data base. To develop the complete nutrient data base required for the project necessitated extensive additional data input.

The first step was to draw up a list of all the food ingredients used in the range of products to be analysed, thereby identifying the gaps in the data base. These groups were: those foods for which Australian data were available in the literature (eg raw meats); those foods for which published Australian data were available but in an inappropriate form (eg dried fruits and vegetables for which data were only available on the fresh products); those ingredients where incomplete Australian data were available (eg flours); and, new items, for which little information was available on nutrient content or availability (eg thickeners and stabilisers).

Local data available

The major source of published Australian data was a series of papers published between 1981 and 1989 (eg Greenfield & Wills 1985).

Dehydrated items

Many of the items in the product range were dry products (eg soup mixes) which incorporated many dried ingredients. Factory specifications all generally included a moisture specification for these ingredients. It was therefore decided to calculate the dehydrated form from the hydrated data. This was viable as only macro nutrients were being considered and few changes of significance occurred to these nutrients during the dehydration process. A conversion formula was built into the computation program enabling conversion of the data for any food to a different hydration level. A similar calculation was not possible in products with varying levels of other nutrients, eg flours.

The diverse range of baked products to be calculated employed wheats with protein levels varying from 9% in the soft protein types to 15% in the high protein durum wheat types necessary for successful pasta manufacture. NUTTAB only included flour with 12% protein content. Although protein levels were available for the flours, it was not possible to do a simple conversion as with the water content.

Incomplete data

In the case of the flours discussed above, appropriate figures were incorporated from food tables from other countries which had appropriate protein levels. Here ingredient specifications were most important to facilitate selection of an appropriate figure from the consulted data. The major sources of data were Paul & Southgate (1978), especially the supplements (eg Tan & others 1985), the German food tables (Souci & others 1981) and the USDA food tables (eg USDA 1989).

New foods for which no data exist

There appeared to be four options to fill the gaps: commission analyses of the ingredients, or at least only accept data based on analysis; generate all data by calculation from ingredient specifications drawn up by the company food technologists; utilise suppliers' data, even though some would be from analysis and some from calculation; or a combination of the last two mentioned.

With an estimated 300 different ingredients to be considered, the first option would have been prohibitive from the point of view of cost and time. Although a large percentage of these ingredients were governed by strict ingredient specifications from the company, only in a few instances were the specifications found to be adequate to enable the appropriate data to be recalculated. For example for the textured vegetable proteins, moisture and sodium levels could be found, but data were inadequate for other nutrient calculations. This limited the application of the second option. The fourth option was chosen but as manufacturers' data were generated both by analysis and by calculation, it was important to determine which had been used in each case so that the data base could be marked accordingly. Inevitably judgements had to be made as to the best value to ascribe to an ingredient or additive. Since these judgements inevitably contained an element of personal bias, it is easy to understand how the studies cited earlier attributed most of the final discrepancies to differences in the data base. As ingredients for the food industry are continually being modified or developed, new data will always have to be generated for computation programs. The data base content is likely, therefore, to remain the weakest link in the system.

Specific difficulties

Specific difficulties were posed by new materials; by flavours and colours; by confidentiality; and by ingredient-free lists.

New materials

With the increasingly complex ingredient supply, new ingredients and additives are being developed about which little is known, particularly regarding nutrient availability. A major example of these little studied additives is the modified starches.

In the food supply of the 80s, modified starches became increasingly common. Modified starches are particularly helpful in adding texture and organoleptic qualities to foods which have reduced fat content. With the drive towards lower fat foods and the sophistication of chemical technology it is to be anticipated their usage will increase. Therefore the question of how resistant the modified starch is to digestion in the human gut becomes relevant and even critical in determining its contribution to the overall nutrient composition of a product. Particular products, like the gravies in the survey, already contain significant quantities of modified starches. The food labelling regulations permit 10% variation in declared energy level and 20% variation in other nutrients, which may not be generous enough when considering a product with such a major contribution from a nutrient of unknown bioavailability.

Flavours and colours

Undoubtedly flavours and colours are the biggest and most diverse group of additives used within the food manufacturing industry, and this group represented the largest group of ingredients in the project. Over the last few years companies have endeavoured to find flavours which may be listed as "natural" and colours which likewise do not have to carry the stigma of "artificial". This change has resulted in an even more extensive range of flavours and colours being employed. The carrier for a flavour is important in determining the ways in which the flavour can be successfully used. Huge variations were found in sodium content depending on the carrier present. Initially it was assumed that savoury flavours would contain up to 40 g sodium per 100 g and sweeter flavours never more than 20 g sodium per 100 g. However, further enquiries of suppliers soon revealed that in some instances new, more natural, sodium-free or lower-sodium carriers were available. However manufacturers, even when not inhibited by confidentiality, were often unable to supply the sodium information required for the data base having never estimated this themselves. The figures eventually used were often a mixture of calculated data and manufacturers' estimations, supplied to satisfy our requests. However, in most products the flavours and colours were present in such small quantities that the variations in data would produce minimal impact on the final results.

In products such as soups where flavours represent a more significant percentage of total weight, initial calculations using the generalised sodium estimations proved to be very different from five year old laboratory analysis figures for some of the products. The revised estimates agreed well with sodium analyses of the new products generated by the company laboratory.

The current demand for products with lower sodium levels will generate more requests to flavour manufacturers regarding the levels of sodium in their products and increase demand for their lower sodium products. As a result it should become increasingly easy to collect sodium data on these products. If fuller nutrient analysis calculations are required then further details of the nutrient composition of the carriers will also be necessary.

Confidentiality

Part of the difficulty in obtaining accurate ingredient data is the importance of this information to the manufacturer. Competition within the ingredient supply industry is fierce. Flavour companies now have vast ranges of flavours, many of which are designer flavours developed by the companies in response to individual requests from manufacturers. Many food technologists have individual additive preferences when building up new product flavours. So in a large company it was not surprising to find there were up to seven beef flavours employed which to the uninitiated appeared to be performing the same function.

The flavour manufacturers have to guard the uniqueness of their products, to remain competitive. Often the difference between one company's particular flavour and their competitior's is the flavour carrier. If the nutritional information were freely available, a discerning chemist from the opposition may well be able to work out the formulation. So to respect the flavour house confidentiality at times an educated guess as to the sodium content had to be made.

Ingredient-free listings

Public interest in food sensitivities generates many of the requests to manufacturers. Consumers are particularly anxious to know whether some specific ingredient of concern is present or not in a food. In addition some consumers are interested to know if products contained added sugar or animal fats. It was decided to compile a positive listing of nine ingredients, wheat, gluten, milk protein, lactose, egg, yeast, added sugar, animal fat and MSG. A listing for the presence of salicylates, anti-oxidants and amines was considered but not published at this stage. As each food item was loaded into the data base, the presence of any of these ingredients was recorded, eg flours all had a positive indication for wheat and gluten. Decisions had to be made about, eg whether eggs should gain two positive listings, for egg and animal fat, and, since MSG is a naturally occurring substance in foods such as tomatoes, whether all tomato products should be listed with MSG.

Conclusion

No system is perfect. Recognition of the major limitations empowers the user with the caution not to misinterpret the final data. The quest for more information about the composition of foods in the diet is laudable and to be pursued, and a data base computation system can augment current knowledge. The individual figures can only ever be a best approximation based on the information available. As these tools are further developed it would be hoped that they become increasingly relevant and useful.

References

Commonwealth Department of Community Services & Health. 1987. NUTTAB87. Nutrient data table for use in Australia. Disk or tape format. Canberra: Commonwealth Department of Community Services & Health.

Frank, CG, Farris, RP & Berenson, GS. 1984. Comparison of dietary intake by 2 computerized analysis systems. J. Am. Diet. Assoc. 84: 818–20.

Greenfield, H & Wills, RBH. 1985. A bibliography of UNSW studies on the composition of Australian foods and related areas. Food Technol. Aust. 37: 460–1.

Haddy, B. 1990. Food composition data and the National Heart Foundation's Food Approval Program. Food Aust. 42:8, s14–15.

Holland, B, Unwin, ID, & Buss, DH. 1987. Cereals and cereal products. London: Royal Society of Chemistry.

Hoover, LW. 1983. Computerized nutrient data bases: 1. Comparison of nutrient analysis systems. J.Am. Diet. Assoc. 82: 501–5.

Hoover, LW & Perloff, BP. 1983. Computerized nutrient data bases: 2. Development of model for appraisal of nutrient data base system capabilities. J.Am. Diet. Assoc. 82: 506–8.

Marsh, A. 1983. Problems associated with recipe analysis. Proceedings of the Eighth National Nutrient Data Bank Conference. Washington, DC: National Technical Information Service, US Department of Commerce.

Paul, AA & Southgate, DAT. 1978. The composition of foods. London: HMSO.

Powers, PM & Hoover, LW. 1989. Calculation of nutrient composition of recipes with computers. J.Am. Diet. Assoc. 89: 224–32.

Shanklin, D, Endres, JM & Sawicki, M. 1985. Computer analysis programs. J. Am. Diet. Assoc. 85: 308–13.

Souci, SW, Fachmann, W & Kraut, H. 1981. Food composition and nutrition tables 1981/82. Stuttgart: Wissenschaftliche Verlagsgesellschaft mbH.

Tan, SP, Wenlock, RW & Buss, DH. 1985. Immigrant foods. London: HMSO.

USDA. 1989. Composition of foods. Raw, processed, prepared. Handbook 8–20. Cereal grains and pasta. Washington, DC: USDA.

Food composition data use for food legislation purposes

R. Peters

This review of the use of food composition data for food legislation purposes covers the following aspects: consumer expectations of food labelling (particularly nutritional and compositional labelling); the regulatory scene; labelling issues confronting the consumer, the regulator, and the manufacturer; the uses and abuses of food composition data; and a brief perspective on possible future developments.

Food labelling

Food labelling is a term that covers a broad spectrum of information, both mandatory and voluntary, that is to be found on packaged food. The mandatory information includes product name, manufacturer's name and address, country of origin, lot/batch identification, net weight, and, in certain instances, nutritional information. Additional voluntary information includes recipes, serving suggestions (pictorial representations), promotional material, product descriptions and, of course, the brand name.

Ingredient labelling is the declaration of components used to prepare food, and nutritional labelling is the declaration of certain key constituents of the food, as determined by analysis, that are significant to metabolism. Food composition data are derived from the detailed chemical analysis of a food.

Nutritional data are a sub-set of food composition data and both have a direct link with ingredient listing.

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Consumer expectations

The subject of nutritional labelling of foods has been given extensive coverage in the media and the general public is becoming increasingly interested in knowing more about the food it purchases and consumes, thus needing clear, informative food labelling which is readily understood. In addition, the initiatives and activities of various government and community-based organisations have been instrumental in raising the profile of nutritional information and food composition data, eg the Commonwealth Department of Health's dietary goals and guidelines (1981) and the recommendations of the Better Health Commission (1987). However, as noted by Downer (1989), these objectives were based on limited data. The opportunity now exists to incorporate recent data to update those objectives.

To provide consumers with the opportunity to develop healthier diets by purchasing foods with known nutritional contents, clearly understood and usable information is needed on food labels. Furthermore, this information needs to be consistent with the public awareness programs being conducted by government and community-based organisations. When national data become available about Australian consumers' current level of understanding of ingredient labelling or nutritional labelling, then strategies can be planned to determine the nutritional information required on food labels, how it can be best presented, and how the purpose of the information can be lastingly communicated to all consumers in Australia, ie the dietary objectives can be matched with the label information, and with the level of consumer information.

Regulatory perspective

Ingredient labelling was introduced in 1978 as a mandatory addition to food labelling, although many manufacturers had already been providing this information voluntarily prior to 1978. The 1978 initiative saw the introduction of class names to describe food additives: mineral salts, colours, emulsifiers, food acids. In 1987 these requirements were complemented by the inclusion of the numbering system for food additives. An alternative was provided whereby the number could be substituted by the name of the food additive. The 1987 initiative also provided more detail about these class names, eg mineral salt (508), colour (160(a)), food acid (330); or alternatively, mineral salt (potassium chloride), colour (β-carotene), food acid (citric acid). The international standardisation of additive numbers and descriptions, through the Codex Alimentarius in which Australia participates through the activities of the Australian Quarantine and Inspection Service in Canberra, should assist in developing consumer awareness.

Nutritional labelling

Regulations covering the descriptive format were agreed upon in 1986 and cover any claims made relating to a food's nutritional content, eg fibre enriched, protein enriched (NHMRC 1989). Where a claim is made a table must appear describing the energy, protein, fat, carbohydrate (total and sugars component), sodium and potassium contents on per serving basis and on a 100 g (or 100 mL) basis. Similarly regulations incorporating nutritional declarations have been developed for Australian Standards: Vitamins and Minerals, and Special Purpose Foods (covering Foods for Special Dietary Uses, Low Joule Foods, Carbohydrate Modified Foods, Canned Foods for Infants and Young Children, Cereal-Based Foods for Infants and Young Children, Infant Formula, and Low Sodium and Low Salt Content Foods). In addition, cholesterol statements are prescribed for polyunsaturated oil and margarine.

Unfortunately, there is little consistency in the prescribed formats for nutritional information for these foods, particularly within the Special Purpose Foods category. Carbohydrate Modified Foods require a percentage composition of the key components and an energy statement per 100 g; Formula Dietary Foods require a statement of the energy content consumed per day as well as the proportions of protein, fat and carbohydrate in the food; Infant Formula requires a table of 28 components expressed per 100 mL as reconstituted; Low Sodium Foods may also have their sodium and potassium contents expressed in millimoles as well as milligrams per 100 g. This situation could obviously lead to confusion in the consumer's mind.

Labelling issues

Who needs the information?

Every consumer, every man, woman and child in Australia, has a need for information about the nutritional value of food consumed. This need has become more important and more complex as more is known about the composition, the metabolic value and the potential hazards of food, and, more importantly these days, there is an infinitely greater choice of foods to consume at our finger tips.

What does the nutrition label mean?

An example of the current confusion may exist in the consumer's minds if they are intending to purchase food to satisfy publicised needs to achieve a healthier, more balanced diet is given by sample labels for protein enriched bread shown in Table 1. Bread A has more protein, but more sodium, less sugar and less fat than Bread B. Both breads are described as "protein increased", but for a consumer with a strong interest in purchasing the appropriate bread for developing a healthier diet, the choice is not particularly straight-forward based on the information presented on the label. Does the sodium content have precedence over protein content, or a lower fat content? Or should bread be considered a component of a broader menu for a daily diet, or a weekly diet, or a life-time diet? And therefore, does it matter if there are slight differences in compositional data of this component food? The critical point is, how can the consumer assimilate the nutritional information presented to them on this one food? There are many more product comparisons that would be equally relevant.

Labelling of sugar content

Sugar labelling has been a subject of contention for some time. Should sugars be labelled as "added sugars" or as "total sugars"? A number of natural, unprocessed foods contain simple sugars, such as lactose in milk, and fructose and sucrose in fruit. However, these sugars are not perceived as constituting health problems for the average consumer. Indeed, general advice is to increase the consumption of fresh fruit for its mineral, vitamin and fibre content. Sugars in whole fruits are not believed to be damaging to teeth or other aspects of metabolism because the way in which nature 'packages' sugar tends to reduce sugar contact with teeth and may delay its absorption into the blood (Anon 1987). Furthermore, the sugar content of fruit can be highly variable depending upon the cultivar and stage of maturity. Further, from a nutritional point of view, the energy intake, often dependent upon the total sugar intake, will be important in any dietary consideration. If total sugars are to be the preferred form for labelling, then most fruits and many vegetables could be designated as being high in sugar content. This would be factually correct, but would require substantial educational input to the population to explain this apparent anomaly.

Labelling of salt or sodium content

Salt has been used as a method of preservation since recorded time. However, the relevance of salt to hypertension and its subsidiary side-effects is becoming well documented and well publicised. The public health concern arises through the addition of salt to foods rather than from that naturally present in foods. Whilst the total sodium content of foods should be given on a label in quantitative terms (g salt or sodium per 100 g of food), some have argued that millimoles of sodium (or sodium chloride) can be better integrated into a dietary objective.

Dietary fibre

Dietary fibre has been a widely used term in the past decade. In recent years there have been substantial developments in our understanding of the term, the composition of dietary fibre, and its physiological effects on the body. Traditionally, the term fibre has been loosely applied to those components of the plant cell wall which escape digestion by the enzymes of the human intestine. More recently, a stricter chemical definition has been developed which refers to non-starch polysaccharides, thereby eliminating minerals, lipids and lignins from consideration as fibre (Anon 1987). All non-starch polysaccharide components escape digestion in the human small intestine, moving on to the colon. This definition of fibre could satisfy those who are concerned with regulatory aspects including scientific accuracy, and those concerned with nutritionally meaningful definitions. However, it is becoming evident that the full meaning of dietary fibre is yet to be unravelled. Manufacturers are bound to label food according to regulations, but is the information on the label meaningful to the consumer in terms of needs, and metabolic effect?

Labelling of fat content in food

Through media advertising, consumers are becoming more aware of the need to monitor intake of polyunsaturated fats, mono-unsaturated fats and cholesterol. As knowledge increases so do the concerns for various aspects of fats and fat-soluble components of our diet. The point comes through again, do we have the necessary information to provide consumers with a clear understanding of their dietary needs?

Uses and abuses of food composition data

There may be need to adopt a "helicopter" viewpoint in addressing the issues surrounding food labelling, so as to avoid the divisions among the many groups, each with a well planned agenda to achieve defined objectives, though often with a narrow perspective. The public is being bombarded with bits and pieces of information concerning their diet and the opportunity to abuse food compositional data then arises. The abuse may take the form of selective promotion of key nutritional groups in isolation from the broader perspective of a balanced diet. The reverse also applies in the case of negative claims. The manufacturer must respond to the changing food information environment and provide pertinent statements or data that will maintain or develop market share for certain products.

Table 1. Nutrition labels for two types of protein enriched bread (per 100g)

Nutrient	Bread A*	Bread B**
Energy (kJ)	985	980
Protein (g)	9.3	9.2
Fat (g)	1.9	2.2
Carbohydrate—total (g)	44.5	46.6
—sugars (g)	0.2	2.5
Dietary fibre (g)	3.4	not stated
Sodium (mg)	605	432
Potassium (mg)	136	112

* serving size 29.6 g
** per slice 28.0 g

The drive for healthier food has seen the description "natural" debased to a point where it is difficult to know whether it really has the meaning the public expect. The term "all natural" is often used to indicate that the ingredients used to prepare the product are natural. However, in an instance where a product is highlighted as "all natural" but its ingredient statement lists potassium chloride and calcium chloride, is the claim "all natural" justified? These particular substances exist in nature, but many may not be satisfied that they are natural. The critical issue is the need to have clear understanding among consumers of the contribution to the diet of ingredients and additives approved for use in food, and their relation to the nutritional goals for Australians.

The future for nutritional advice on food labels

The issues surrounding information presented to consumers through labels, advertising and publicity are complex. The need to know more about the food we eat is undisputed. The problem lies in how to convey the necessary nutritional information in a form that is readily understood and that can be assimilated into the wider perspective of better health and well-being, bearing in mind that the ultimate choice is that of the consumer. The difficulty with a numerical tabulation of nutritional data on labels is that the consumer not only has to understand the units in which the nutrient is expressed, but then has to collate the information on several nutrients depicted in different terms, eg kilojoules, grams, milligrams, millimoles. If this has been achieved, consumers can then choose the brand of food which conforms most closely with their wishes. But then the consumers somehow have to integrate information on all their food purchases if they wish to maintain their diet in accordance with established guidelines. The integration of such information has been recognised for some time, both internationally and in Australia, and has led to the statement that there is no such thing as an unhealthy food and that the balance of food choices is the key to an appropriate diet.

This leads to the opportunities for the future. Perhaps the pictorial representation of nutritional information, as is being developed in the UK, has merit. However, it may be more pertinent at this moment to determine what Australians currently understand with respect to food, nutritional and compositional labelling and what consumers want to and need to know. Such a survey would need to be appropriately detailed to cover the spectrum of the Australian population, and structured in such a way that the gaps in understanding can be identified, and future regulations, public awareness campaigns and advertising guidelines developed accordingly. Access to considerable food data is now possible but there may be little benefit in presenting such data through food labels unless consumers can clearly understand them and appropriately collate and assimilate the information against dietary objectives. There needs to be a national approach to address all the issues to reduce the potential for misunderstanding and abuse of food data. Meanwhile, there is a real risk that consumers will become totally apathetic towards the nutritional information prescribed by regulation on food labels.

References

Anon. 1987. Nutritional labelling of foods: a rational approach to banding. London: The Nutrition Advisory Committee, The Coronary Prevention Group.

Better Health Commission. 1987. Towards better nutrition for Australians. Canberra: AGPS.

Commonwealth Department of Health. 1981. Dietary guidelines for Australians. J. Food Nutr. 38: 111–9.

Downer, A.H. 1989. Dietary goals, guidelines and guesswork. Food Aust. 41: 916.

National Health & Medical Research Council 1989. Food Standards Code. Canberra: AGPS.

The New Zealand food composition data bases

B.A. Burlingame

DSIR Biotechnology is the site of New Zealand's national nutritional data bases and one of its main centres for nutrient compositional analyses. The data base project has been developed and maintained in conjunction with a systematic nutrient analysis project. Both are ongoing, with constant updating. This overview of New Zealand's direction in the area of nutritional information systems covers the information structure, groups involved and their roles, work completed to date, problems encountered, and future prospects.

Information structure

Nutritional information systems require involvement at international, regional (Oceania) and national levels. As does Australia, New Zealand participates in a United Nations University program called INFOODS (the International Network of Food Data Systems), headquartered at Harvard University, USA. The purpose of this group is to make recommendations and establish protocols for the compilation of nutritional information systems. An early activity of INFOODS was the establishment of regional groups throughout the world. New Zealand became part of OCEANIAFOODS, along with Australia, member countries of the South Pacific Commission, and Papua New Guinea.

There are three New Zealand nutritional data bases: the *Main food and feed database*, the *NZ food composition database*, and the *NZ therapeutic database of brand-name foods.* Each has been designed for specific purposes with unique features and capabilities.

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The main database of food and feed

The *Main database* was developed using recommendations and design criteria from the International Feed Information Centre (INFIC) (Lelystad, The Netherlands). Data on both human foods and animal feeds are entered into this data base and the staff are able to search the data base at the request of a client. New Zealand is possibly the only country associated with INFOODS which developed its food composition data base from a foundation of an animal feed data base. This did have some advantages, including on-site personnel familiar with computerised nutritional data systems.

The NZ food composition database

The *NZ food composition database* contains nutrient composition on 1122 human foods in 22 categories. Of these foods, 42 percent are based on New Zealand source data and five percent are based on Australian data from literature sources (Wills & others, 1981a, 1981b, Wills & Greenfield 1982, Greenfield & others 1981, 1982) and appropriately referenced in the user's guide (Burlingame & Milligan 1989). The remaining food records are made up of British data from three sources (Paul & Southgate 1978; Paul & others 1980; Wiles & others 1980). A copyright arrangement for the use of some of these data has been entered into with HMSO and royalty payments are made by DSIR based on numbers of computer and printed copies produced for sale.

The data are available for purchase in the form of the printed *NZ food* *composition tables* (Milligan & others 1989), and computer products called FOODfiles and FOODsearch. An example of a typical food record in the *NZ food composition tables* is given in Figures Ia and 1b. In this example, nutritional information for wholemeal flour, 100% extraction rate, is presented as amounts per 100 g edible portion. The first part of the record includes the proximates, elements, vitamins and cholesterol. The next two parts show amino acid and fatty acid data. The final part of a food record presents additional information and various record identifier codes. In the example in Figures 1a and 1b, additional information includes different measures of dietary fibre and its important constituents.

The first edition of the printed version is presently available as an unabridged reference book, complete with statistical variation, number of samples associated with the mean values and country source data. It has 1600 pages and is similar in format to the US Department of Agriculture Handbook No. 8 series (USDA 1976–89). An abridged version will be ready by mid-1990 which will contain nutrient mean values only and come in a form similar to the British tables (Paul & Southgate 1978).

FOODfiles is also presently available. This product consists of data files for inclusion in the users' applications software or data base management system and is supplied as a set of ASCII files on either standard half-inch magnetic tape or 5.25" floppy disks. FOODfiles requires computing expertise for installation.

FOODsearch, a ready-to-use software package, is presently being developed. This product contains all the data files plus application software with capabilities for selection, display and calculations using user-defined scaling factors. Average daily nutrient intakes of individuals and populations can be determined, and compared to RDIs of several different nations. Totals will be flagged to indicate where nutrient values are missing from one or more of the food records used in the calculation. (Information on FOODfiles and FOODsearch may be obtained from the author).

The NZ therapeutic database of brand-name foods

The *NZ therapeutic database of brand-name foods* is different from traditional food composition data bases and tables in that it provides information on brand-name foods only, and provides much more information than simply the nutrient composition of the foods.

FLOUR, WHEAT, 100% E. R., Wholemeal

Amount in 100g edible portion	Units	Mean	Std error	No.	Src.
PROXIMATES					
Water	g	12.31	0.17	62	z
Energy	kcal	305	-	-	c
Energy	kJ	1274	-	-	c
Protein (Nitrogen × 5.83)	g	11.84	0.11	38	z
Total fat	g	1.84	-	1	z
Available carbohydrate	g	64.15	-	1	z
Dietary fibre	g	8.56	-	1	z
Ash	g	1.57	-	2	z
NUTRIENT ELEMENTS					
Sodium	mg	8.34	-	2	z
Magnesium	mg	142	-	2	z
Phosphorus	mg	398	-	2	z
Sulphur	mg	136	-	2	z

Chloride	mg	38.7	-	-	b
Potassium	mg	529	-	2	z
Calcium	mg	59.3	-	2	z
Manganese	ug	4340	294	6	z
Iron	mg	5.42	-	2	z
Copper	mg	0,532	0.056	6	z
Zinc	mg	3.15	0.51	6	z
Selenium	ug	1.24	0.21	7	z
VITAMINS					
Retinol	ug	0	-	-	b
Carotene	ug	0	-	-	z
Total vitamin A equivalents	ug	-	-	-	-
Thiamin	mg	0.467	0.049	4	z
Riboflavin	mg	0.118	0.012	4	z
Niacin	mg	7.26	0.05	3	z
Potential niacin from tryptophan	mg	2.05	-	-	z
Vitamin B6	mg	0.510	-	-	b
Pantothenate	mg	0.816	-	-	b
Biotin	ug	7.14	-	-	b
Folate, total	ug	58.1	-	-	b
Vitamin B12	ug	0	-	-	b
Vitamin C	mg	0	-	-	b
Vitamin D	ug	0	-	-	b
Alpha-tocopherol	mg	1.5	-	1	z
Vitamin E	mg	-	-	-	-
OTHER LIPIDS					
Cholesterol	mg	-	-	-	-

	g/100g edible portion				mg/g Nitrogen			
AMINO ACIDS	Mean	Std error	No.	Src.	Mean	Std error	No.	Src.
Isoleucine	0.391	-	1	z	192	-	-	z
Leucine	0.759	-	1	z	374	-	-	z
Lysine	0.322	-	1	z	159	-	-	z
Methionine	0.180	-	1	z	89	-	-	z
Cystine	0.275	-	1	z	135	-	-	z
Phenylalanine	0.511	-	1	z	252	-	-	z
Tyrosine	0.350	-	1	z	173	-	-	z
Threonine	0.341	-	1	z	168	-	-	z
Tryptophan	0.123	-	1	z	61	-	-	z
Valine	0.502	-	1	z	247	-	-	z
Arginine	0.568	-	1	z	280	-	-	z
Histidine	0.256	-	1	z	126	-	-	z
Alanine	0.436	-	1	z	215	-	-	z
Aspartic acid	0.625	-	1	z	308	-	-	z
Glutamic acid	3.504	-	1	z	1726	-	-	z
Glycine	0.474	-	1	z	233	-	-	z
Proline	1.174	-	1	z	578	-	-	z
Serine	0.606	-	1	z	299	-	-	z

Figure 1a. Sample record from the NZ food composition tables (Milligan & others 1989).

Dietitians recognised that they required additional information about food which would not be included in the *NZ food composition database and tables.* At a joint meeting of the New Zealand Dietetic Association and the Nutrition Society of New Zealand in 1984, a working group convened to discuss their needs and thus conceived the idea of the therapeutic database.

This brand-name foods database contains industry-supplied information on ingredients, nutrient composition, manufacturer and product details, and the presence and absence of clinically significant food constituents (Figure 2). Nutrient composition data are subject to quality assurance checks. Each individual entry requires disclosure of whether the data were obtained from direct analyses, calculated from food composition tables, or from unknown means, by ticking the boxes on the form labelled A, C, and U, respectively.

FLOUR, WHEAT, 100% E. R., Wholemeal

	g/100g edible portion				g/100g total fatty acids			
FATTY ACIDS	Mean	Std error	No.	Src.	Mean	Std error	No.	Src.
4:0	-	-	-	-	-	-	-	-
6:0	-	-	-	-	-	-	-	-
8:0	-	-	-	-	-	-	-	-
10:0	-	-	-	-	-	-	-	-
12:0	-	-	-	-	-	-	-	-
14:0	0.003	-	-	z	0.23	-	-	z
15:0	-	-	-	-	-	-	-	-
16:0	0.245	-	-	z	18.48	-	-	z
17:0	-	-	-	-	-	-	-	-
18:0	0.019	-	-	z	1.43	-	-	z
20:0	-	-	-	-	-	-	-	-
22:0	-	-	-	-	-	-	-	-
24:0	-	-	-	-	-	-	-	-
Total saturated	0.267	-	-	z	-	-	-	-
10:1	-	-	-	-	-	-	-	-
14:1	-	-	-	-	-	-	-	-
15:1	-	-	-	-	-	-	-	-
16:1	-	-	-	-	-	-	-	-
17:1	-	-	-	-	-	-	-	-
18:1	0.204	-	-	z	15.39	-	-	z
20:1	-	-	-	-	-	-	-	-
22:1	-	-	-	-	-	-	-	-
Total mono-unsat	0.204	-	-	z	-	-	-	-
18:2	0.711	-	-	z	53.62	-	-	z
18:3	0.138	-	-	z	10.41	-	-	z
18:4	-	-	-	-	-	-	-	-
20:2	-	-	-	-	-	-	-	-
20:3	-	-	-	-	-	-	-	-
20:4	-	-	-	-	-	-	-	-
20:5	-	-	-	-	-	-	-	-
22:2	-	-	-	-	-	-	-	-
22:4	-	-	-	-	-	-	-	-
22:5	-	-	-	-	-	-	-	-
22:6	-	-	-	-	-	-	-	-
Total poly-unsat	0.849	-	-	z	-	-	-	-

Additional information (in 100g edible portion)	Units	Mean	Std error	No.	Src.
Dry matter	g	87.69	0.17	62	z
Total nitrogen	g	2.03	0.02	38	z
Total available sugars	g	3.77	-	1	z
Starch	g	60.38	-	1	z
Hemicellulose	g	7.15	-	2	z
Pectin	g	0.35	-	1	z
Cellulose	g	1.63	0.21	3	z
Lignin	g	1.04	0.32	3	z
Neutral detergent fibre (Van Soest 1967)	g	8.56	-	1	z
Crude fibre (AOAC, 1970)	g	2.41	0.07	16	z
Boron	ug	492	-	2	z
Chromium	ug	8.02	2.08	4	z
Cobalt	ug	1.14	-	1	z
Nickel	ug	<72.7	-	-	z
Molybdenum	ug	18.3	-	2	z
Cadmium	ug	5.86	0.62	4	z
Delta-tocopherol	mg	0.158	-	1	z
Beta- and gamma-tocopherol	mg	2.98	-	1	z
Density	kg/1	0.690	-	-	1c

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Figure 1b. Sample record from the NZ food composition tables (continued).

Groups involved

Three main groups have been involved in important aspects of this work: the DSIR (Biotechnology Division and Chemistry Division), the NZ Health Department, and the Food Composition Steering Committee. Other organisations have contributed to the development of these databases by making grant money available, including the NZ Heart Foundation, Cancer Society of NZ, Lottery Board, Palmerston North Medical Research Foundation and the NZ Dietitians' Association.

3 PRESENCE/ABSENCE

a Clinically significant food constituents

Tick the box to show the Presence (P) or Absence (A) of the food constituents in the product. If uncertain indicate unknown (U)

	P	A	U		P	A	U
GLUTEN				YEAST			
WHEAT				LACTOSE			
EGGS				SOY			
DAIRY PROTEIN				BEEF			

b Clinically significant food additives

Tick the box to show the Presence (P) or Absence (A) of the clinically significant additive classes in the product. If uncertain indicate unknown (U)

BHA/BHT P [ ] A [ ] U [ ]

Butylated hydroxyanisole (320) Butylated hydroxytoluene (321)

SULPHUR DIOXIDE P [ ] A [ ] U [ ]

Sulphur dioxide (220) Sodium sulphite (221) Sodium bisulphite (222) Sodium metabisulphite (223)
Potassium metabisulphite (224) Calcium sulphite(226) Calcium bisulphite (227) Potassium bisulphite (228)

BENZOATE P [ ] A [ ] U [ ]

Benzoic acid (210) Sodium benzoate (211)

GLUTAMATE P [ ] A [ ] U [ ]

Glutamic acid (620) Monosodium glutamate (621) Monopotassium glutamate (622) Calcium glutamate (623)

AZO Colours P [ ] A [ ] U [ ]

Tartrazine (102) Sunset yellow FCF (110) Carmoisine (122) Amaranth (123)
Ponceau 4R (124) Brilliant Black PN (151) Brown HT (155)

6 NUTRITIONAL INFORMATION

Please tick appropriate boxes to indicate form of product for which nutrient information is being provided.

a [ ] AS PURCHASED

- i [ ] per 100 grams
- ii [ ] other weight/volume, and description [ ]

b [ ] AS CONSUMED

- i [ ] per 100 grams
  Specify materials and their amounts [ ]
- ii [ ] other weight/volume.
  Specify materials and their amounts [ ]

Please provide as much nutritional information as is available for each product and indicate the method of nutrient determination (i.e. tick the A box if analysed in a laboratory, tick the C box if calculated from food composition tables, or tick the U box if the method is unknown).

Nutrient	Value	Units	A	C	U

Nutrient	Value	Units	A	C	U

Figure 2. The therapeutic database of brand-name foods data entry form. Two sections of the data entry form are shown: presence/absence of clinically significant food constituents and food additives, P = present, A = absent, U = unknown; and nutritional information, A = analysed, C = from food composition tables, U = unknown.

DSIR Biotechnology has been the primary site for organisation, and has played an important role in funding, sampling, analyses, and presentation of the data. Chemistry Division has also been involved in sampling and analyses, particularly vitamin analyses. The Health Department historically has funded much of the work and health inspectors have assisted with the sampling of foods from different regions of the country. Finally, the Food Composition Steering Committee has had the role of advising on various aspects of the work including the setting of food category priorities, selection of food constituents to measure, and procedures for sampling. The Committee, which over the years has included nutritionists, dietitians, health department officers, food technologists, and academics in food technology and human nutrition, has the obligation to review the information needs of nutrition professionals and consumers, and consider these in relation to the food composition work.

The composition of New Zealand foods

Most of the New Zealand source data come from the systematic nutrient analyses of foods, begun at Biotechnology Division in 1980, and conducted in collaboration with Chemistry Division. To date, comprehensive nutrient data have been obtained for New Zealand produced fruits, vegetables, dairy products, fish and cereal grains. In addition to the systematic nutrient determinations, other data were collected from research laboratories around the country and incorporated into the data base after meeting all the established criteria for high quality data.

Problems

The challenge of these projects are many and include managing the limited resources such that the nutrient analyses conducted according to the guidance of the Steering Committee will ultimately replace all British data with New Zealand source data; maintaining the validity and integrity of the data selected for inclusion into the data bases; satisfying the wide mix of data base users with the end products; and sustaining funding from both the DSIR and the Health Department as the usefulness of all the data bases depends entirely on continual revision and updating.

Future

The maintenance and upgrading of nutrient composition data bases and tables will carry on with continued support from the NZ Health Department and the Department of Scientific and Industrial Research. Analytical work will continue to focus on major categories of foods. Currently, bread and flour analyses are being conducted and future categories will include beef, lamb and meat products, traditional Maori and Pacific Island foods, and fast foods. Supplements and addenda to the printed and electronic data bases will be issued periodically, the first of which will be on breads and flour.

Specialised data bases and printed products will also be developed. Educational materials for secondary school students are being prepared jointly by staff of DSIR and a team of home economics teachers convened by the Education Department (now the Ministry of Education). Specialised printed products include the continuation of the soft-cover book series called the *Composition of New Zealand foods* (Visser & Burrows 1983). Books two (export fruits and vegetables) and three (milk and milk products) will be published in early 1990 and the first draft of book four (bread and flour) is in preparation, to be published in late 1990.

In New Zealand, as in many other countries, nutritional information is important for many sectors of the population. The future will see this information required and put to use by agriculturalists and geneticists in the development of new breeds and strains; business personnel involved in the marketing of food products; food technologists in the development of new, healthier manufactured foods; dietitians, epidemiologists and other health practitioners in advising on and evaluating food intakes of individuals and populations; policy makers in advising national bodies on nutritional goals and guidelines and on product labelling; and most importantly by consumers making wise purchasing decisions.

References

Burlingame, BA & Milligan, GC. 1989. The New Zealand food composition tables user's guide. Palmerston North, NZ: DSIR Biotechnology.

Greenfield, H, Chuah, LK & Wills, RBH. 1981. Composition of Australian foods. 12. Hamburgers. Food Technol. Aust. 33: 619–20.

Greenfield, H, Wimalasiri, P, Ma, SNN & Wills, RBH. 1982. Composition of Australian foods. 16. Foods from Pizza Hut restaurants. Food Technol. Aust. 34: 364–7.

Milligan, GC, Webster, DW & Burlingame, BA. 1989. The New Zealand food composition tables. Palmerston North, NZ: FOODDATA Biotechnology Division, DSIR.

Paul, AA & Southgate, DAT. 1978. The composition of foods. London: HMSO.

Paul, AA, Southgate, DAT & Russell, J. 1980. First supplement to McCance and Widdowson's *The composition of foods.* London: HMSO.

US Department of Agriculture. 1976–89. Composition of foods. Raw, processed, prepared. Handbook 8 series. Washington, DC: USDA.

Visser, FR & Burrows, JK. 1983. Composition of New Zealand foods 1. Characteristic fruit and vegetables. DSIR Bulletin 235. Wellington, NZ: DSIR.

Wiles, SJ., Nettleton, PA, Black, AE & Paul, AA. 1980. The nutrient composition of some cooked dishes eaten in Britain: a supplementary food composition table. J. Hum. Nutr. 34: 189–223.

Wills, RBH & Greenfield, H. 1982. Composition of Australian foods. 18. Foods from Kentucky Fried Chicken. Food Technol. Aust. 34: 566–9.

Wills, RBH, Makinson, H. & Greenfield, H. 1981a. Composition of Australian foods. 9. Meat pies, sausage rolls and pasties. Food Technol. Aust. 33: 450–4.

Wills, RBH, Wimalasiri, P & Greenfield, H. 1981b. Composition of Australian foods. 5. Fried take-away foods. Food Technol. Aust. 33: 26–7.

Recommendations

The Symposium resolved that the following list of recommendations which were produced by workshops and agreed to in plenary session should be transmitted to Federal and State Ministers of Health:

1. The Symposium commended the Commonwealth Department of Community Services and Health highly for the production of the new official *Composition of foods, Australia* (COFA) (Cashel & others 1989) and the related computer data base NUTTAB (Commonwealth Department of Community Services & Health 1989). This publication and the ongoing associated program were recognised to be of indispensable value for the promotion of better health in Australia and essential tools for the ongoing monitoring of the nutritional quality of the national food supply.
2. The Symposium recognised the need for a commitment of ongoing resources to secure the future of the program, and that these resources not only be for continuing analytical work but also, and most importantly, for the qualified staffing resources required for the scrutiny and management of the analytical data in the production of the printed tables and computerised data base. The need for printing and computer costs was also recognised by the meeting.
3. The Symposium noted that many of the analytical data which had been produced under the program were still awaiting release and urged that high priority be given to releasing these data as additional volumes of COFA as soon as possible.
4. The Symposium also noted the complexity and size of the first volume of COFA and urged that a set of simplified tables for consumer use be produced as soon as possible.
5. The Symposium noted that specialised needs for data on non-nutrients in foods existed but believed that top priority should still be given to analysing more foods for the existing nutrient profile as soon as possible. The priorities for foods on which nutrient data are needed are: non-alcoholic beverages; dairy products; confectionery; take-away foods (non-branded); ethnic group foods; baby foods; infant formulas; sauces and pickles; and frozen packaged meals.
6. The Symposium agreed that the priorities for nutrient data should be as follows: proximate data and a carbohydrate profile should be generated on all foods and top priority should be given to this; other nutrients should be prioritised on a public health needs basis; where analytical data cannot be obtained by reason of expense, lack of facilities etc, data should be estimated from overseas data for similar foods; calculation factors are needed for nutrient losses and gains during processing, storage and preparation; a method to indicate bioavailability of nutrients in particular foods is needed for compiled data; research into methodology for nutrients such as folate, vitamin B_{12}, vitamin B_6 and biotin should be carried out.
7. The Symposium urged that a mechanism be found for laboratories commissioned under the Australian analytical program to publish their data independently on completion of analysis of particular groups of foods, in recognition of the delays necessitated by the data management and printing processes in production of the printed tables and NUTTAB.
8. The Symposium noted the use, potential use and potential for abuse of nutrient data in the labelling and promotion of foods, and recognised the need for consumer education programs

to enable the public to use the information to the best advantage in terms of health and value for money.

9. The Symposium noted the size and price of the first volume of COFA and the availability of NUTTAB. It stressed the need for a review of the pricing structure of such an essential public information resource; the desirability of a package comprising tables and diskette to be available for purchase; the need for the tables and NUTTAB to conform with each other; the need for the tables to contain the additional feature of printed lists of foods by nutrient so that the comparative value of foods could easily be recognised; the need to extend the computer format; and the usefulness of an independent glossary of food names.

10. The Symposium noted that the original advisory committee structure for the program had been of necessity modified over time, and highlighted the need for groups of end users to be requested to make formal inputs into the program in the future.

References

Cashel, K, Lewis, J & English, R. 1989. Composition of foods, Australia. Canberra: AGPS.

Commonwealth Department of Community Services and Health. 1989. NUTTAB89. Nutrient data table for use in Australia. Disk format. Canberra: AGPS.