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EXPERIENCES IN FOOD COMPOSITION STUDIES AT THE NATIONAL AND INTERNATIONAL LEVEL

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Summary

Much progress still remains to be made world-wide in the field of food composition data production, management and use. The main advances in the last decade have been the development of reference materials for nutrient analysis of foods, together with some improved methods of nutrient analysis. More detailed attention must be paid to the field of food composition in epidemiological studies of diet and health. The future management of the food supply for the benefit of public health as well as the economy will rely on high quality comprehensive food and nutrition information systems. Strong national data base programmes are required supported by mechanisms for regional and international data interchange. To this end greater reliance on the fields of information and computer science will be needed in the future. There are clear implications of such developments for the primary training of nutritionists.

I. INTRODUCTION

The original involvement of our group in food composition studies arose from the needs for dietary surveys within the context of assessment of community nutritional status. For these and other needs it was clear that a national Australian data base of compositional data generated by local analysts on locally consumed foods was required and an analytical programme commenced to produce data for such a data base (Greenfield and Wills 1979). Later opportunities arose to be involved in related programmes internationally. Very little assistance was available from the literature at the time of programme commencement. Attempts were therefore made to document all aspects as fully as possible in order to encourage local workers to generate good quality food composition data, to support food composition data base compilers and to improve the training of the next generation of data users (Wills, Balmer and Greenfield 1980; Greenfield and Wills, 1981; Greenfield and Southgate 1985; Greenfield 1987; 1990a; 1990b; Southgate and Greenfield 1988; 1991).

A brief evaluation of the current status of the field of food composition data production, management and use follows.

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II. NATIONAL LEVEL

At the national level it has been pleasing to see the sustained level of official support for more than a decade which has enabled the ultimate establishment of a local food composition data base of high quality in computer (NUTTAB) and print (COFA) formats (Department of Community Services and Health 1989-91).

(a) Data production

It is commendable that the policy of the Department of Community Services and Health has been to publish virtually only Australian analytical data in its food tables, and to commission or stimulate the generation of completely new data on foods including those of ethnic groups; few countries have such a new unequivocal well-documented indigenous resource available. It is also pleasing that singular local efforts have been made to analyse Aboriginal bushfoods. Future priorities may need to include obtaining additional analytical data from all of the different states of Australia particularly for foods which are important items of consumption (e.g. beef, milk) or those known or suspected to vary between states because of varying conditions, practices or regulations (Greenfield and Kosulwat 1991).

There has been an increase in the local expertise available in food composition work and it is gratifying to note the development of a central government laboratory in South Australia which maintains a suite of nutritional analytical services (Scheelings and Buick 1990). It has also been rewarding to note the increase in the number of Australian laboratories signalling an interest in food composition contract work, from very low levels at the start of the programme to over 100 when recommissioning of the national programme was undertaken in the late 1980s (Greenfield 1990a). Hopefully local expertise will be developed in the additional nutrients for which facilities do not currently exist. Nowadays there is considerable awareness of analytical methodology in Australia and it is doubtful that much local support would be found for Willett's view (1990) that for any one nutrient all foods should be analysed by the same method.

The increased interest in nutrient analysis of foods is undoubtedly linked to the welcome advent of new food regulations such as nutrition labelling. However, scrutiny of food labels indicates some unsatisfactory aspects of labelling requirements and possibly some flawed information appearing on labels. The lack of a specified method in the regulations for some nutrients leaves a loophole whereby analytical results cannot be adequately monitored. If a method is not specified then, presumably, results by any method are equally satisfactory, even where it is known that different methods do produce widely differing analytical values. Further where the method is known to be of low nutritional application then neither the consumer nor the regulator is served with useful information. An example is carbohydrate by difference which is no longer acceptable to nutritionists but which at the time of writing was specified for total carbohydrate values in nutritional labelling in the NSW

Pure Food Act (1989). The benefits of harmonising the approaches for the national nutrient data base and nutrition labelling would be considerable not least in the necessity for only one set of analyses for at least two applications.

Experiences in our analytical programme have re-emphasised the desirability of nutritionists being involved in nutrient analytical programmes as the primary training of most analytical chemists does not involve close consideration of foods as articles for consumption and as such subject to varying practices in that process. It is therefore often difficult to establish all the essential items of food description, including ingredients, portions considered edible or inedible and thus included or excluded from the analytical sample, detailed recipes and cooking procedures. The present involvement in Australia of nutritionists in commissioning food analytical programmes and scrutinising and compiling the data for publication in tables and data bases is commendable and must be continued.

(b) Data base application

In view of the investment made over a decade in the Australian programme (English 1990) there is a need to see the national data base widely applied. It could be employed as the basis for nutrition labelling of some primary and some composite foods (the latter approach would be preferable to any current labelling based on nutritionally unsatisfactory methods). The benefits to the food industry of expert systems based on national food composition and local food regulations would be immeasurable (Feinberg, Ireland-Ripert and Favier 1991b). One would like to envisage a national food supply monitoring system akin to the Danish system which monitors the levels of desirable and undesirable components in foods (Bilde and Leth 1990) meeting needs in the fields of both environment and health. The current focus on nutrition in the Health for All initiatives (HTIC 1988), highlights the importance of the nutrient data base as a key tool in health promotion and nutritional epidemiology. However, future needs will require a complex of food and nutrition information systems. Hence the national food composition data base should be integrated within a network of linked food and nutrition information resources (food disappearance statistics, national and other dietary surveys, market basket surveys, household purchasing surveys, data bases of non-nutrients in foods, risk factor prevalence surveys, food production and retail sales statistics) which would provide the basis for population food and nutrition policy and planning.

(c) Research needs

There is a need for good research in Australia to test the national data base in use e.g. against duplicate diets. In addition local quality control tools could be developed (Hoover and Perloff 1983) which would enable users to validate their results. Such studies would provide pointers to any additional data or other modifications needed, as well as providing some estimate of the reliability of nutrient intakes computed by use of COFA. Such estimates will be required for the long-term tracking of the national diet implicit in national nutrition policy. There is also a need to consider maintaining food or duplicate diet archives as well as maintaining archival copies of each version of NUTTAB to indicate time trends in food composition.

(d) Training

The information needs of the future imply expansion and upgrading of training in nutrition. While this is occurring there appears to be no common approach to training in nutritional analysis of foods; or the methodological underpinnings of food composition data production, management, and use; or on information systems. This situation must be reversed. The field can only become more complex as interest in nutrients and other components in foods expands and as the number of new food products continues to increase. It is only with the requirements of future generations of nutritionists that one can expect to see new methods of analysis established and maintained in existing laboratories. Further, advances in information technology have to be taken into account.

III. INTERNATIONAL LEVEL

The initiatives taken by INFOODS to stimulate international cooperation in food composition data production management and use (Rand et al. 1987; Klensin et al. 1989; Truswell et al. 1991) were very valuable and do not appear to have been replaced by international collaboration of the same scope, although the continuing regional efforts which pre-dated or became associated with INFOODS have kept the dialogue alive (e.g. English and Lester 1987; Becker and Danfors 1990).

(a) Data production

Some consider that there is a multitude of good analytical data available and all that is required is a system to collate and interchange them. That appears to be true for Latin America (Bressani 1990), but world-wide the quality and availability of data are highly variable. Initial investigations in Australia (Cashel pers. commun.) revealed the existence of very few local food composition data in the literature; and extensive computerised bibliographic searches combined with correspondence with individual researchers, food companies etc produced very few food composition data of recent origin in the Pacific at the start of the Pacific Islands Food Composition Programme (Greenfield 1990a). A multi-country prospective study of diet and cancer in several European countries has uncovered the very patchy nature of data availability; some have very few indigenous data (Slimani 1991). Some highly industrialised wealthy countries do not have any food tables, although one suspects the availability of at least some good quality data. A country such as Indonesia comprises diverse geographical regions each with distinctive food cultures; the majority of currently available data originate mainly from Java and are incomplete in terms of the desired range of nutrients. Truly national tables would ultimately require a network of food sample collectors, and probably regional laboratories as well as new equipment, training of personnel and the development of a central data management resource (Greenfield 1991).

It has been pleasing to see advances in methods of analysis for vitamin A, folates and dietary fibre over the last decade (Greenfield and Southgate, in press). However, undoubtedly the most significant advance has been the development of food reference materials for nutrient analysis of Western foods (Wolf 1985; Wagstaffe 1990). The availability of these invaluable tools has done much to increase the amount and quality of data available and to streamline the work of the analyst. The development of undried frozen reference materials for the determination of the less stable organic constituents of foods is eagerly awaited (Wolf, Iyengar and Tanner 1990). The applicability of the available reference materials for non-Western diets is a question requiring resolution.

(b) Nomenclature

Considerable work has been done on the nomenclature of foods in order to facilitate the storage, classification and retrieval of food data by descriptors, in schemes such as the Factored Food Vocabulary (McCann et al. 1988) and Langual (Feinberg, Ireland-Ripert and Favier 1991a), and the INFOODS system (Truswell et al. 1991). More reliance on developments in classification system theory may be needed in future (Dahlberg 1988). It is interesting that in computerised biological taxonomy Australia has led the way with the DELTA system (Lance and Williams 1967; Watson et al. 1988). This system is available for microcomputers, handles descriptive and numerical data, and utilises cluster as well as hierarchical structures for classification. Programs for interactive identification which are similar to expert systems include on-screen colour graphics and facilities for translation into several natural languages. There would be obvious advantages in the incorporation of such features into classification systems for foods.

(c) Data base management systems

A serious barrier to progress is the lack of a universal data base management system (DBMS) for food composition data or indeed any readily available general guidance about computer systems for food composition data management. However, Klensin (1987) has presented a useful general discussion of the systems options.

Carmody (1987) has described the development of the Australian Nutrient Data Bank, a mainframe system based on the proprietary software FOCUS. The estimates of time and personnel involved, and the developmental steps and systems features described would be very useful to others commencing a similar task. The US Nutrient Data Bank is a mainframe system comprising approximately 150 different computer programs and uses over 100,000 lines of programming code (Perloff 1991). Feinberg, Ireland-Ripert and Favier (1991b) have provided a list of some of the common data calculations which will require programmes in any DBMS for food composition data. In other national or international programmes commercial PC database software has been modified for use. Much effort would be spared and progress made if at least the general requirements in terms of hardware and software could be defined for data bases of specified potential dimensions, and the common programming tasks spelled out.

(d) Data base use

It would be useful to identify and quantify the potential for bias introduced by use of food composition data bases or tables, preferably as a component of large-scale dietary studies. However, the lack of measures of dispersion in most food composition data bases and tables will make this difficult and could necessitate analysis of duplicate diets (themselves subject to error) or the use of biological markers (again not free from complications). Large-scale multicentre prospective studies of diet and health may be able to provide some of the answers to such questions though they initially generate many questions of their own (Slimani 1991). The difficulties associated with a multi-country user data base are similar to those of any data base, for example, the exact identification of each food, the missing nutrient values, the absence of any analytical data at all for a food, the unknown sources and uncertain reliability of analytical data contributing to uncertainty about representativeness.

Beaton (1987) has carried out simulation computations with US food composition data (for which standard error data are published) on model diets and has at least established that variability in food composition appears to produce only a small bias in nutrient intakes computed for diets comprising many as opposed to few foods. This work also indicated the need to analyse or replicate analyses of foods which are major suppliers of dietary nutrients. The problem of missing or imputed data is undoubtedly a major potential source of error with missing values treated as zero likely to produce major underestimates while imputed or borrowed data are likely to produce random errors.

Stockley (1988) has reviewed studies of errors associated with missing values in data bases, citing underestimates of B vitamin intake ranging from 1.5% to 14.3%, and recoveries of only 69% of total polyunsaturated fatty acids analysed in duplicate diets, improving to 89% when missing values in the tables were filled in. The potential error of using of out-of-date data is also discussed. New analyses of starch in UK potatoes produced values ranging from about 11 to about 23 g/100 g according to cultivar, with the average value (weighted by tonnage) being 17.0g, against which could be compared the value in the food tables of 20.3 g/100g. Potential intake of starch from potatoes may therefore be only 60% of that given in the tables.

The studies that have been done do seem to highlight the need for high quality analytical data that are as up-to-date and complete as possible; this reinforces the requirement for a sound laboratory basis for food composition work and all of the studies that flow from such work.

IV. CONCLUSION

Many major tasks still lie ahead in the field of food composition, mainly in data base management and use. Such data bases will prove a vital part of the future information needs for food and nutrition policy and planning. The secular changes in foods, the food supply and food habits, and the expanding interests in food components affirm the needs for constant monitoring. It would appear therefore that to meet future information needs for food and nutrition policy and planning nutritionists will have to become more rather than less expert in the field. It is also clear that the requirement for continuing high standards in terms of the laboratory base of food analysis cannot be relaxed.

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