SYSTEMATIC DEVELOPMENT OF NATIONAL FOOD COMPOSITION DATA: A GUIDELINE

Tee E Siong

Division of Human Nutrition
Institute for Medical Research,
Kuala Lumpur, Malaysia

SUMMARY

Information on the composition of foods is the essential basis for the quantitative study of nutrition and its application in the treatment and management of disease, and the provision of appropriate diets for individuals or population groups. In view of the growing need for quality food composition data, there has been a worldwide increasing interest in the generation and compilation of such data. Similarly, in ASEAN, each member country has put in some effort to improve its national food composition databases. With the realization that past activities have been largely uncoordinated, there has been emphasis on the need for systematic development of national food composition data system. This paper aims at providing some guidelines for developing such a system. The first step in the establishment of such a systematic programme would be the setting up of a natioal working group, with membership comprising of data users, generators and compilers. The group should then identify the objectives and goal of the programme, and draw up a plan of action. Since some information on food composition data already exists in the country, the first stage in this plan would be to carry out a thorough review and evaluation of this information. This would enable the identification of the work to be carried out in the second stage, that is the generation of new data. All data obtained, either from the literature or newly generated, would then be compiled for publication. The systematic execution of these stages of the programme would facilitate the setting up of a comprehensive food composition data system which is more meaningful and useful. Each of these stages are discussed in this paper, taking into consideration the existing situation and constraints in countries in the region.

1. INTRODUCTION

Food composition data are of importance in various fields of food and nutrition research and activities. Information on the composition of foods is the essential basis for the quantitative study of nutrition and its application in the treatment and management of disease and the provision of appropriate diets for individuals or population groups. In nutrition research, such information is essential for studies of the effects of variations in nutrient intake on reproduction, growth and development and in studies of the relation between diet and health or disease. The quantitative assessement of the nutritional value of the diet of individuals or population groups likewise depends on information on the composition of foods combined with information on food consumption. Planning of diets for institutions and feeding programmes as well as diet and nutrition counseling also depends on information on the composition of foods. Finally, there is increasing demand for these data from individual consumers, with greater awareness that what people consume is the basic determinant of their health (Bruce and Bergstrom, 1983; Vanderveen and Pennington, 1983; Rand, 1984; Rand et al., 1987; Greenfield and Southgate, 1987).

In view of the growing need for food composition data, there has been a worldwide increasing interest in the generation and compilation of such data. A significant development was the formation of the International Network of Food Data System (INFOODS) in 1983, aimed at improving the amount, quality, and availability of food composition data all over the world (Rand, 1984). Subsequent to this development was the establishment of various regional INFOODS groups. The inaugural meeting for the formation of ASIAFOODS was held in Bangkok in 1984. ASEAN Food Data Network is a special subgroup set up for countries in this

region and held its first workshop in Jakarta in 1986. The workshop is viewed as an important step towards efforts to systematize, standardize and update the generation and compilation of food composition data, as well as to facilitate the use of the data in the ASEAN region.

Food composition data generation in ASEAN is not a recent undertaking. There has been several food composition tables in all countries in the region for many years. However, in recent years, there has been renewed interest in this field in all countries in the region. Each member country has put in some effort to improve its national food composition databases. In addition, an important development in the region is the increased awareness of the need for cooperation among member countries in order to achieve their common goal. A number of workshops have been held in the last 8 years to enable ASEAN scientists working in this field to exchange experiences and information. Two workshops on food analytical techniques were organized, the first in 1981 in Singapore and the second in 1984 in Surabaya, Indonesia. This was followed by a comprehensive workshop on several aspects of food composition data generation and compilation in Jakarta in 1986. The present workshop provides yet another forum for interaction.

This paper aims at providing some guidelines for the development of a systematic programme for the generation and compilation of national food composition data. The discussion is based mainly on experiences of the author in executing such a systematic programme in Malaysia since 1980 (Tee, 1989), which culminated in the recent publication of a Malaysian food composition table (Tee et al., 1988), views and recommendations expressed by various scientists in the region in the three ASEAN workshops on food composition data, as well as the comprehensive INFOODS

Manual prepared by Greenfield and Southgate (1987). The paper takes into consideration the existing constraints in the region, and is particularly geared towards the needs of the region. It is not the intention of this paper to belittle existing food composition data generation programmes or to contradict current practices of these systems.

2. PLANNING FOR A SYSTEMATIC PROGRAMME

In all countries in the region, there existed some form of food composition analyses, refered to in this paper mainly as nutrient composition. However, these activities carried out by various institutions in the country are usually not coordinated. Duplication of analyses exist, and much of the data may be incompatible or unsuitable for inclusion in a food table. For many foods, only a limited number of nutrients were analysed, and these varied from one institution to the other. The data may even be scattered among the various institutions, with no serious effort to compile them. It is precisely due to these discrepancies that there is increased awareness of the need for a systematic programme for the generation and compilation of national food composition data.

The first step in the establishment of such a systematic programme would be setting up of a national working group for the compilation of food composition data. Members of the working group should be carefully identified, and should include data users, generators and compilers. It is important to include users of food composition data in the group, as the data generated should meet the needs of users. Various types of data users should be identified, including nutritionists, dieticians, planners, educators and food scientists. All institutions actively involved in the generation of data should be included,

as well as those with the potential to participate. The data compiler should have the expertise to scrutinise and compile data. Finally, a lead institution would need to be identified to coordinate the programme. Dedication to the programme would be the most important criterion for identifying the coordinator. The lead institution may also be the data compiler, although it is not necessarily so.

The first task of the working group would be to identify the objectives and goal of the food data system to be developed. It would be useful to hold a national workshop to define the needs and uses of food composition data. The format of the food table or database, the range of nutrients and foods to be analysed and other details should be agreed upon. A survey using a questionnaire may also be carried out to obtain greater coverage of users. All information collected would guide the group in developing the data system.

Next, the working group would have to draw up a plan of action to tackle the task at hand. Assuming some information on food composition data already exists in the country, the first stage in this plan would be to carry out a thorough review and assessment of this information. This would enable the identification of the work to be carried out in the second stage, that is the generation of new data. All data obtained, either from the literature or newly generated would then be compiled for publication. The systematic execution of these stages of the programme would facilitate the setting up of comprehensive food composition data system which is more meaningful and useful.

3. REVIEW OF EXISTING INFORMATION AND SYSTEMATIC EVALUATION

It may not be desirable to build up the food composition data system from totally new analyses. Most countries in the region do not have the resources to do so. It would be more cost-effective to establish a system based on existing literature as well as new analyses. It is thus necessary to review available information, to define the state-of-the-art of the subject. The objective would be to : (1) determine what data are available and (2) which of these can be used for inclusion in the new database. The information obtained would then form the basis for defining the work programme in the next stage. The review and evaluation should be undertaken by the compiler institution.

All possible sources of available information, namely publications, food tables, as well as unpublished reports and data should be systematically reviewed and evaluated. A thorough search of the literature is required. Contact to various institutions would help extend the coverage. Each of these sources of informattion have their own characteristics and limitations that would have to be taken into consideration in the evaluation process. Publications in journals usually have well documented methods of sampling and analysis, but they frequently deal with only a few nutrients. Data in secondary publications such as reviews and previous editions of food tables are more difficult to evaluate, since it may not be possible to trace the source of the data. Unpublished reports could provide valuable data for the database, but their usefulness can be rather variable and sampling and analytical procedures need to be scrutinized. Whatever the source of information, it is clear that the data cannot fully meet all the criteria set for those to

be analysed. There cannot by any retrospective control of the sampling, analytical method or laboratory quality control of data obtained from the literature.

A systematic listing of information would answer the question of what data are available. It is a tedious task, but with the help of a database computer software, the process can be made very much easier to handle. All required information including name and description of food, methods of sampling, preparation and determination, units, and source of data should be carefully recorded to enable the evaluation of the data. If and when necessary, recalculations or conversions have to be carried out so that values from different sources are expressed in the same way to permit comparison.

To determine which of the available data may be included in the data system is a difficult task. Several criteria may be considered during scrutiny of the data. All foods accepted for inclusion should be identifiable unambiguously, including name (and, where applicable, species or variety) of the food and part of the plant or animal that comprises the food. For processed and cooked foods, the ingredients used should be known. The manner of obtaining the sample should be known, together with information on number studied and place of purchase. The nature of the sample analysed should be clearly stated, i.e. whether raw or cooked, or processed, and the methods used in processing. Sample preparation and analytical procedures are important criteria in the evaluation of data. It should be ascertained that samples for analysis were properly prepared, e.g. precautions to avoid destruction of nutrients or contamination, and to ensure homogeneity of sample. In evaluating the analytical methods used, preference should be given to values

obtained by means of validated or proven methods, and where the source gives indication of quality assurance procedures. Another point not to be overlooked is to understand the modes of expression used, and to ensure that the conversion factors used, if any, are clearly stated.

Once all the values and relevant information have been inventorised, scrutiny of the data for acceptance can be carried out. Where a number of entries from various sources agree within the limits of the methods used, the values could be accepted with confidence. If the number of values for a nutrient is large, the arithmetic mean or median may be calculated to arrive at a single value. When the number of values is small, and large discrepancies exist between values, it is necessary to determine if the large variation is due to outliers or due to values derived from unsatisfactory analytical or sampling procedures. In such cases, the compiler would have to exercise some judgement and select values that have a higher level of confidence, for example properly documented data obtained with appropriate method, and quality assurance programme.

For some of the food items listed, there may be only a few nutrient entries. It may become necessary to combine values from a variety of sources to make up for the complete range of nutrients. Before this can be done, it is vital to ensure that the various sources being used are compatible. If there are only one or two nutrients listed for each food item, it may be better to omit these foods and carry out fresh analyses of all the nutrients.

4. GENERATION OF NEW DATA

After the compilation of existing data, the working group can then decide on what new information is required. A plan on the foods and nutrients to be analysed in the next phase and the sampling and analytical methods to be used can then be drawn up. Generation of new data is probably the phase that will take up the most resources, in terms of time, manpower and finance.

4.1 Selection of Foods

Ideally, a comprehensive food composition database should contain data for as many foods as possible. However, since resources are often rather limited, it would be necessary to rank in order of priority the foods to be analysed. A list of food groups to be considered can be prepareed, e.g. following the grouping given in the FAO Food Table. Within each food group, the items to be studied can then be selected, based on several considerations, depending on the needs of the country. For countries in the region, one of the most important considerations would be foods related to nutritional deficiencies in the community. Attention should be given to foods which are known, or are suspected to be, good sources of the nutrients concerned. The food consumption patterns of the country could be a useful guide to the selection, and foods most frequently consumed in greater amounts may be given higher priorities. Also to be given higher priority would be foods which are specific or unique to the country, since data on these foods would not be available elsewhere. Certain foods may be given particular attention due to their importance as exports. Input from various quarters are required for this selection of foods, particularly from users of the data.

4.2 Selection of Nutrients

Again, due to limitations in resources, it would not be possible to have data for all the nutrients that are known or suspected to be important in human nutrition. A decision will thus have to be made on the nutrients to be studied in the analytical programme. Availability of resources woulld obviously be an important determinant in the selection of nutrients, but other factors would also have to be considered.

Priorities ought to be given to nutrients related to the health and nutritional problems of the country. For countries in this region, where nutritional deficiencies remain a major concern, data on protein, energy, minerals and vitamins would be most required. The list of nutrients given in the FAO Food Table (may be refered to as "conventional food table nutrients") would be a good start. This list would also be in general agreement with that given in the national recommended dietary intakes/allowances. However, in ASEAN, there is also growing concern of the increasing prevalence of disorders related to nutritional excesses or the so-called degenerative diseases, such as coronary heart disease, diabetes, hypertension and cancer. It would thus be desirable to give some priority to the analysis of fat, cholesterol, fatty acids, and available and unavailable carbohydrates.

An important consideration in the selection of nutrients would be the availability of reliable analytical methods. In addition, the feasibility of using the methods by the institutions participating in the analytical programme should be taken into consideration. It is no use saying an HPLC method would be the method of choice for the determination of carotene and retinol if most of the laboratories do not have the

instrument. The analysis of nutrients have been given particular emphasis in this discussion. It is recognized that other food components including natural components with physiological or toxic properties, contaminants, and food additives, also have a significant role in the relation between diet and health and disease. It would be ideal to have information on these components in the database as well. However, the resources available may not permit their inclusion in the programme, but could be studied later or taken up in a much smaller scale.

4.3 Sampling Procedures

Proper sampling of foods is of fundamental importance to the production of meaningful food composition data. Correct sampling procedures would ensure that the foods taken for analysis are representative of those available to or consumed by the populations concerned. Furthermore, it is to ensure that the portions taken for analysis are representative of the foods collected.

It is recognized that the subject is extremely complex and for obvious reasons, a truly random sampling scheme could not be adopted in many laboratories in the region. This has been highlighted by participants to the Workshop for the ASEAN Food Data Network held in Jakarta in 1986. Sampling points have often been governed by practical considerations such as ease of availability, and the number of samples studied were often determined by resources available to the laboratory. In addition, there has been a lack of proper documentation of methods of taking samples for analysis. In cognizance of the situation, the Workshop suggested several measures to be taken to improve sampling procedures. The Workshop felt that a rigid sampling scheme would not be practical and recommended broad

guidelines for determining sampling points for raw, processed and prepared (cooked) foods. It was recommended that laboratories go through a check-list of factors that may be affecting variability in nutrient content in order to arrive at a sampling scheme. The analyst is expected to prioritise the group of factors listed, which may vary with the food or food group under consideration. The Workshop also emphasized the need for proper documentation of the sampling procedures used, as well as details of the foods received by the laboratory.

It is felt that for immediate use, the broad guidelines as given in the Workshop may be followed in the development of a national food composition data system in ASEAN. The Workshop had recommended various studies to arrive at more well-defined sampling procedures for the future. These include studies to determine more precisely sources and extent of variability in nutrient content, and studies on key food items within food groups to arrive at a model sampling scheme.

The working group would also have to work out a plan to be followed by all laboratories after receiving samples for analysis. These include procedures for labelling of foods received, precautions to be taken in the preparation of foods for analysis to avoid nutrient loss and contamination, procedures for preparation of different types of foods, and the storage of food samples.

4.4 Analytical Programme

In the generation of food composition data, a great deal of importance has been given to the analytical methods used. Indeed, reliable data can only be obtained by the careful performance of appropriate and accurate analytical methods in the

hands of trained analysts, and the values validated through laboratory quality control measures.

The matter of analytical methods has been discussed in at least three workshops organized by the ASEAN Sub-Committee on Protein. Two earlier workshops, held in 1981 (Singapore) and 1984 (Bandung) were dedicated entirely to the subject. In the more recent workshop in Jakarta in 1986, a session was devoted to the discussion of analytical methodologies. Existing methods of food analysis among the ASEAN countries have been documented in the form of manuals and distributed. It is now clear that with regards to the analysis of conventional nutrients in food tables, the methods in use have been established for their reliability elsewhere and recommended or adopted by relevant international organization. It is recognized that the development of new methods is too expensive and time-consuming for countries in the region, and have been carried out only in a limited number of cases. Most of the development work relate to evaluating, improving and modifying the currently available methods.

Nevertheless, the working group would need to inventorise the various methods in use by the different laboratories and come to an agreement on a set of methodologies to be used in this programme. It would not be possible to have a set of standard methods which all laboratories should use. It should be quite acceptable for laboratories to use different methods for the analysis of a nutrient, provided these methods are well accepted procedures, and that the methods used are noted. Inter-laboratory variations, to be dealt with later in this section, should be studied and minimized.

Another aspect of the analytical programme that should be given greater attention by countries in the region is that of laboratory quality control. All laboratories should conscientiously carry out measures to assure the quality of analytical data. This has also been emphasized in the Workshop for the ASEAN Food Data Network in 1986, and called for the maintenance of quality control measures and good laboratory practice. Measures should be taken the avoid errors in laboratory analyses, to identify them when they occur, and to provide procedures for correcting them when they do occur.

Several simple measures may be taken to ensure reliability of the data generated. One of the first thing to do is to ensure that various basic laboratory parameters are in order. These include the proper functioning of laboratory equipment, correct preparation of reference standards, and correct choice of chemicals. These are simple procedures, but nevertheless often neglected and could be sources of error and cause considerable delays to the analytical programme. Duplicate analysis of a food sample is usually a minimum requirement in the validation of analytical data. Agreement between duplicates usually indicate that no gross mistakes were being made, although they do not rule out the possibility of making the consistent mistakes. Recovery studies could be carried out by adding a known amount of the constituent to the food being analysed. When the food is spiked with a pure standard, it should be noted that the added constituent is not in the same physical state as in the food and may therefore be more easily extracted. Thus, good recovery may not necessarily indicate satisfactory performance. However, poor recovery does indicate that something is amiss with the method. Other check procedures that may be carried out include re-analysis of the sample by another analyst and carrying out "blind analysis".

Other procedures that may be carried out for the verification of laboratory or method performance include the use of various standard reference materials (SRM). The US National Bureau of Standards (NBS) produces SRMs for several nutrients. The use of NBS standards are still rather limited, mainly because of the lack of SRMs with matrices suitable for food analysis, and the high cost of such materials. Other forms of standard materials that may be used are "house standards". These are really large amounts of food material that are thoroughly homogenized and stored for periodic analysis, with the results being monitored by means of control charts. These are very much alike pool sera used in quality control programmes in clinical biochemistry. Obviously, such house standards must be able to be stored over a long period of time.

Another check procedure that needs to be carried out in this systematic development of a national food composition data system where various laboratories are involved is studies of inter-laboratory variations. Variations in the analytical results for a nutrient obtained by different laboratories need to be minimised since data from various sources are supposed to be pooled in the compilation process. Investigations and corrective measures ought to be carried out when large variations exist between laboratories.

5. COMPILATION OF FOOD COMPOSITION DATA

Prior to the compilation process, an important aspect that needs to be considered and agreed upon by the working group is regarding the format of the database, which encompasses several issues. It may first be desirable to consider if a computerised database would be set up. This would be prefered as data management becomes very much simplified. Furthermore, a

computerised database would facilitate the preparation of a programme for the calculation of nutrient intake from food consumption studies. If a system analyst or programmer is not available to design a dedicated programme for the database, commercial spreadsheet or database programmes could be used quite satisfactorily. Other aspects to be agreed upon related to the format include the nomenclature and description of foods, nomenclature for nutrients and the mode of expression of values.

The compilation process at this stage would be to merge or add on the newly generated data to those already in the database, the latter having been extracted from the literature (discussed in Section 3). It should be emphasized that the compilation process is not merely a clerical task of entering data into a pre-determined format. All data submitted to be compiled should be subjected to scrutiny prior to acceptance to the database, based on various criteria. Several criteria that should be considered in the evaluation of data have been discussed in Section 3 when dealing with the compilation of existing data. Whenever deemed necessary, the participating laboratories would be requested to verify the data submitted, for example checking the calculations, or repeating the analysis.

6. CONCLUSIONS

This paper emphasizes the main areas to be considered in establishing a feasible national food composition data system for countries in ASEAN. Only broad principles involved in the development of the system have been discussed. Details of various stages involved, e.g. sampling procedure, sample preparation, analytical methods, and quality assurance measures, are given in various books and publications in the references cited.

It is hoped that efforts will continue in all ASEAN countries to improve the available food composition data, and in a systematic manner. Various constraints exist in all the stages of development of the data system. All the institutions in the region involved with food composition data generation also have numerous other duties to perform. These are not particularly glamorous research areas and funding may be difficult to obtain. Very often only a limited number of staff members may be available for the required work programme. These personnel will have to be well-trained in various aspects of the programme in order to arrive at quality data. More importantly, the morale of the staff will have to be maintained. A motivated and dedicated work force is a must for successful implementation of the programme. These various constraints are not cited as excuses for the lack of quality data in the region. Rather it serves to emphasize the need to make various efforts to overcome these constraints.

ACKNOWLEDGEMENTS

I thank the Organising Committee of the Workshop for inviting me to present this paper. I would also like to express my gratitude to the Director General of Health Malaysia for permission to participate in this Workshop and present this paper.

REFERENCES

Bruce, A. and Bergstrom, L. (1983). User requirement for databases and applications in nutrition research. Fd Nutr. Bull., 5 (2) : 24-29.

Greenfield, H. and Southgate, D.A.T. (1987). Guidelines to the Production, Management and Use of Food Composition Data System. An INFOODS Manual.

Rand, W.M. (1984). The need for an international food data system. In : Proceedings of the First ASIAFOODS Conference, 17-21 September 1984 (Rand, W., Stuckey, A., Valyasevi, A. and Tontisirin, K. eds), pp. 20-24.

Rand, W.M., Windham, C.T., Wyse, B.W. and Young, V.R. (editors) (1987). Food Composition Data : A User's Perspective. United Nations University, Tokyo.

Tee, E.S., Mohd. Ismail, N., Mohd. Nasir, A. and Khatijah, I. (1988). Nutrient Composition of Malaysian Foods. ASEAN Sub-Committee on Protein : Food Habits Research and Development, Kuala Lumpur; 150 p.

Tee, E.S. (1989). Food composition data generation and compilation in Malaysia. Country report presented at the ASEAN Workshop on Food Data System, 25-27 October, 1989, Bangkok, Thailand.

Vanderveen, J.E. and Pennington, J.A.T. (1983). Use of food composition data by governments. Fd Nutr. Bull., 5 (2):40-45.

PROCEEDINGS

ASEAN WORKSHOP ON FOOD DATA SYSTEM

ASEAN INTERIM PROJECT MANAGEMENT
COMMITTEE ON PROTEIN

25 – 27 OCTOBER, 1989
BANGKOK, THAILAND

Supported by Japan International Cooperation Agency (JICA)