SESSION IV

STRENGTHENING NUTRITION SCIENTIFIC INFRASTRUCTURE

NATIONAL FACILITY FOR SYSTEMATIC ANALYSIS OF FOODSTUFFS

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Globally, data on the nutrient composition of foods is recognized as a key element in many areas like agriculture, nutrition, dietetics, health assessment, labeling, food regulations, consumer protection, formulation of policies and a variety of applications in trade, research and development.

Information on the nutritive value of Indian foods (Text Box 1) was first published in 1937 by Dr. W.R. Aykroyd[1]. This booklet popularly known as Health Bulletin No. 23, underwent many revisions and was widely used by both professionals and the common people. It was rewritten in 1971 by Drs. Gopalan, Ramasastry, and Balasubramanian and published under the title, "Nutritive value of Indian foods" (NVIF)[2]. This book provides information on the nutrient composition of nearly 600 Indian foods based, mostly carried out at the National Institute of Nutrition (NIN), Hyderabad (formerly Pasteur Institute in Coonoor) and other research Institutes and University laboratories. Taking into account the newer information that had accumulated over the years on the nutrient composition of Indian foods, and to overcome some of the shortcomings of the earlier publication, it was revised and updated in 1989[3]. The revised edition contains new data on trace elements, non-nutrient content of some foods (specially iron content), total carotenes, β-carotene and fibre content in selected foods. Apart from modifications in the presentation of the tables, the nutrient compositions of common foods and less familiar foods have been listed under different sub-titles. The edition also includes a succinct update on nutrients and their functions, nutrient requirements and recommended dietary intakes (RDI), habitual diets in India and their adequacy, nutritional deficiencies and their prevention and control. The 1989 edition of NVIF has been reprinted several times. In the 2004-reprinted book, the new database generated at NIN on total, insoluble and soluble dietary fibre, invisible fat and its component individual fatty acid contents have also been added.

Text Box 1
Nutritive Value of Indian Foods

1937	Akroyd	Health Bulletin No. 23
1971	Gopalan, Ramasastry & Balasubramanian	Nutritive value of Indian Foods (NVIF) 600 raw foods Mainly NIN, other research inst. & Univ.
1989	Narasinga Rao, Deosthale & Pant	Revised & Updated NVIF New data on trace elements, total carotenes & β-carotene & fibre Overview on nutrients, their functions, requirements, prevention of deficiency diseases, their prevention and control Modifications in the presentation of tables
2004	Reprint	New data on Total, insoluble and soluble fibre Total invisible fat (free, bound & cell wall) and individual fatty acids
1994-2004		Nutrient composition of less familiar foods

Users of Indian food composition data

Planners, agriculturists, nutritionists, medical and health professionals as well as the general public extensively use the data in the NVIF (Text Box 2). Diet surveys conducted on a countrywide basis by the National Nutrition Monitoring Bureau (NNMB) use the information in the NVIF to compute nutrient intakes. In addition, the Indian food composition data is used for planning food supplies or rations at national, community or group level, such as for formulating supplementary feeding schemes, nutritionally adequate and therapeutic diets and for planning food production on sound nutrition

Text Box 2
Users of NVIF

Agriculture, nutrition, medical & health professionals, planners and general public

- Computation of dietary nutrient intakes, component of nutrition monitoring & surveillance
- Planning food production on sound nutrition principles
- Developing dietary guidelines for healthy individuals
- Planning and implementation of National Nutrition Policy
- Minimum wages fixed on nutrient / food requirements
- Academic & research institutes (Agric, food science, nutrition and dietetics, broad spectrum of activities on diet, health & diseases)
- Recent years demand increased due to greater awareness of role of diet in prevention of obesity and chronic diseases
- PAST 5 Yrs 3500 copies have been sold.

principles. The nutrient and food requirements calculated from this database is also used for fixing minimum wages. Academic and research Institutes in agriculture, food science and nutrition require the nutrient composition data for a broad spectrum of activities defining the relationship between diet, health and disease. The demand for this book by individuals has increased, in recent years because of increased awareness of the role of diet in the prevention of obesity and chronic diseases. It may not be out of place to mention that in the last 5 years 35,000 copies were sold.

Need to revise and update Indian food composition data

It is essential to recheck the values given for several nutrients, and generate a new database for nutrients which have not been incorporated (for several food values for vitamins and minerals are lacking) as well as non-nutrient chemicals whose importance has now been established. As mentioned earlier, a major part of the data in NVIF were generated decades ago and the data included in later editions are only on selected nutrients, the analysis of which was carried out at NIN using market samples from Hyderabad and Secunderabad. Therefore, the new data included in the revised edition is not a nationally representative sample. Over the years, traditional varieties have been replaced by high yielding varieties. Furthermore, the new agronomic and husbandry practices followed in different parts of the country, locational, geographic differences, climate and changes in composition of soil due to application of fertilizers/pesticides/herbicides can contribute to change in the nutrient composition. In addition, new varieties with altered nutrient composition (eg. new varieties of rice which has higher percent of protein, high oleic acid) are now being grown.

In view of the emerging data that fresh organic produce contains on an average more vitamins, minerals, enzymes and other micronutrients than intensively farmed produce, there is consumer demand for organic foods. Therefore, it is important to generate information on organic foods and compare the data with foods grown with current agronomic practices. The introduction of genetically modified foods (GMF) in the market will call for the regular monitoring of nutrient composition of these foods in relation to other agricultural produce. Also several of the analytical methods used earlier were laborious and time consuming and/or less sensitive. Modern technology offers newer, more precise, sensitive and rapid analytical techniques for estimating nutrients and non-nutrients in foods, thus it is essential to take up the task of reassessment of nutritive value of Indian foods (Text Box 3).

As mentioned earlier, the NVIF has been used for computing the recommended dietary

Text Box 3
Need for Comprehensive Revision of NVIF

- To obtain data on NVIF
- High yielding / new varieties
- Agronomic, husbandry practices
- Soil composition (fertilizers, pesticides, herbicides)
- Geographical location, seasonal changes
- Some of the earlier analytical methods are obsolete
- For several foods, values for vitamins & minerals are not given.
- New data included for some nutrients are not on nationally representative sample
- Data for recently identified nutrients / bioactive phytochemicals (which have either positive or negative role in diet-related chronic diseases) not given.

* need for comprehensive revision

allowances (RDA) for Indians[4]. The NIN carried out extensive studies on the prevalence of protein-energy malnutrition, particularly the energy gap, deficiencies of vitamins and minerals. The prophylaxis and dietary treatment of these deficiency diseases were arrived at from the information given in the NVIF. In the last decade, the urgent need for computing nutrient requirements for building body stores and preventing diet-related chronic diseases has been emphasized upon. In India, while frank nutrition deficiencies continue to be widely prevalent, the recent problems due to obesity, overnutrition and diet-related chronic diseases (diabetes, cardiovascular diseases and cancer) are of equal concern. Since nutritional factors are strong determinants in the etiopathogenesis of chronic diseases, it is necessary to compute the nutrient requirements for the prevention of diet-related chronic diseases. For this purpose, it is essential to obtain new data on nutrients/ non-nutrients, which play a significant role either positively or negatively in the etiology of chronic diseases. In this context, data needs to be generated on total sugars, starches, total fibre and its soluble and insoluble fractions, fat (invisible fat) and its constituent individual fatty acids, the natural cis and technologically introduced trans-isomers of fatty acids, cholesterol, antioxidants (individual carotenoids, tocopherols, tocotrienols, vitamin K, selenium etc). The observed association of the high consumption of fruits, vegetables and legumes with a reduced risk for cancer and other chronic diseases, has stimulated an interest in phytochemicals in foods. Currently, there is worldwide emphasis to investigate the relationship between phytochemicals (phytoestrogens, isoflavones, lycopenes etc.) to health promotion as well as pathogenesis of diet-related chronic diseases. Therefore, it is essential to have a database on potentially bioactive constituents move that are naturally occurring in foods (phytochemicals) as well as intentional food additives, pesticides, contaminants and heavy metals. To date the database in the NVIF is on raw foods. The changes in food pattern in India demand an extension of the analysis to processed foods and fast foods.

Text Box 4
Categories of Foods for which Databse Needs to be Generated

- Raw foods (most commonly consumed, less familiar foods and any new food item consumed in area of sample collection)
- Cooked food recipes*
- Bakery foods / processed foods / fast foods
- Organic foods
- Genetically modified foods

* All India Co-ordinated Research Program in Home Science, ICAR, 2002 / nine state Agric. Univ, Proximate principles Ca, Fe, Vit. A, β-carotene & Vit. C of 200 recipes

National Facility For Generation of New data

Ideally, the revised database should provide data for as many nutrients and non-nutrients that promote human health. It is also important to generate a database on anti-nutritional factors, non-nutrients and contaminants that have a negative impact on human health. This is a huge task in terms of money, time and manpower. It might be appropriate to constitute an apex advisory committee consisting of representatives from the Planning Commission, Indian Council of Medical Research (ICMR), Indian Council of Agricultural Research (ICAR), Department of Biotechnology (DBT), Department of Women and Child Development (DWCD) and Nutrition Foundation of India (NFI). Apart from giving the much needed direction to this national project, the advisory group could extend financial support for the execution of this monumental task. Two lead research institutes, namely NIN at Hyderabad and Agricultural Research institute in North India, can be the centers for the research project on the revision and updating of the database of Indian food composition. These coordinating centers can identify six regional centers located in agriculture research institutes or universities representing different regions of India (North, South, East, West, Northeast and Central).

Selection of foods

The foods to be analyzed fall into the following categories: commonly consumed foods (raw), prioritized for the 300 most commonly consumed foods, and all less familiar foods listed in the NVIF. Any new food item that investigators in each area come across, should be collected and this exercise can be extended

to the rest of the commonly consumed foods so as to complete the 600 foods included in the present NVIF edition. In addition, it is essential to analyze organic foods (sample number will be limited), bakery foods, processed foods and fast foods (Text box 4).

The two coordinating centers, in consultation with the six regional centers would work out the details for sample collection by adopting appropriate statistical procedures and making composite mixtures of each food to ensure that the food analysed is representative of those available or consumed by the entire population in the region. They would work out details for the collection of samples (time, season for collection), preparation of composite mixtures, preservation, packing, labeling and transportation to the two coordinating centers as well. An appropriate cold chain has to be created for perishable items. Furthermore, it is important to ensure that portions taken for analysis are representative of the foods collected.

Selection of nutrients

The list of nutrients anti-nutritional factors to chemical to be analyzed is given below.

Text Box 5
List of nutrients, antinutritional factors, phytochemicals, heavy metals and pesticide residues

I. Nutrients

i) Proximate Principle

1. Percent edible portion
2. Moisture
3. Protein
4. Fat
5. Ash
6. TTDF total fibre
7. Insoluble fibre
8. Soluble fibre
9. Carbohydrate
10. Energy

ii) Vitamins

a) Water soluble vitamins

11. Thiamine
12. Riboflavin
13. Niacin
14. Folic acid
15. Pyridoxine
16. Pantothenic acid
17. B_{12} (animal foods)
18. Ascorbic acid

b) Fat soluble vitamins

19. Vitamin A
20. Tocopherols (isomers)
21. Tocotrienols (isomers)
22. Carotenoids
23. Vitamin K
24. Vitamin D

iii) Minerals and trace elements

25. Calcium
26. Phosphorus
27. Iron
28. Magnesium
29. Manganese
30. Copper
31. Zinc
32. Chromium
33. Nickel
34. Sodium
35. Potassium
36. Iodine
37. Iron
38. Selenium

iv) Amino Acids

39. Arginine
40. Histidine
41. Lysine
42. Leucine
43. Isoleucine
44. Valine
45. Threonine
46. Cystine
47. Methionene
48. Tyrosine
49. Phenylalanine
50. Glycine
51. Glutamic acid
52. Aspartic acid
53. Serine
54. Proline
55. Alanine
56. Tryptophan

iv) Fatty acids

57. Lauric
58. Myristic
59. Palmitic
60. Stearic
61. Oleic
62. Linoleic (n-6
63. α-linoleic (n-3)
64. Behenic
65. Arachidonic
66. Eicosapentaenoic
67. Docosahexaenoic
68. Cholesterol (animal foods)
69. Unusual fatty acids (erucic & others)

II. Antinutritional factors & phyto-chemicals

70. Tannins
71. Phytates
72. Goitrogens
73. Phytochemicals (phyto-
(estrogens, flavones, isoflavones)

III. Heavy metals

74. Lead
75. Mercury
76. Arsenic
77. Cadmium

Text Box 6
Standard Operative Procedures (SOPS)

- Precise identification of foods
  Geographic region, cultivar, brands, etc.
- Preparation of composite mixtures by regional/co-ordinating centres (Representative of food consumed by entire population)
- Storage, packing, labeling, transportation
  (Perishable foods appropriate & feasible cold chain)
- Seasonal variation (for selected foods)
- Dissecting, cleaning/washing, weighing, homogenization

Analytical Techniques

The selection of AOAC modern methods for food analysis is essential. The modern technology-based analytical techniques offer microprocessor based or software based, user-friendly operation procedures and also have built in self-check procedures to ensure desired operating conditions. They also incorporate validation procedures and their implementation. The technology permits the automation and ease of operation in addition to improved sensitivity. Further, it offers possibility of net sharing and net servicing. The techniques however require high investment for equipment, high quality of solvents and refined sample processing. Apart from this, the analytical chemist requires training for the operation and maintenance of this sophisticated equipment. The responsibility of the coordinating units would be to set up food analysis laboratories on GLP norms, select AOAC procedures, standardize and validate the procedures and establish good quality assurance program (external and internal). A manual with Standard Operating Procedures (SOPs) should be prepared on sampling procedures, processing of samples and analytical techniques (Text box 6). Besides this, workshops should be conducted to train the entire team in the coordinating centers and regional centers for food sample collection and analytical procedures. Finally, it is essential to develop software for the computation of food composition data taking into account the future options for networking and net sharing.

Conclusion

In the past, revision and updation of the nutrient composition of Indian foods has not received the due priority because of several constraints in all stages of development of the database. It is important to highlight that the institutes or research groups involved in food composition database would also need to carry out several other research projects simultaneously. Hence creating a food composition database is not a glamorous research area and the required funding is difficult to obtain. It is hoped that discussions based on this paper will help to generate the required funding for establishing a national infrastructural facility for food analysis and identify a motivated and dedicated work force drawn, from various disciplines, for the successful implementation of this programme.

References

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