PROCEEDINGS OF WORKSHOP ON ESTABLISHING FOOD COMPOSITION DATA FOR THE ARAB COUNTRIES OF THE GULF (GULFOODS)

AL AIN, UAE
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PREFACE

The need for data on the nutrient content of food consumed in Arab countries of the Gulf has been emphasized by several governmental organizations in the region, in order to serve as a tool for nutrition education and to help in planning special diets for therapeutic purposes, as well as to assist in designing and implementation of food regulations, particularly those associated with nutritional ingredients.

As the Arab countries of the Gulf have similar socio-cultural characteristics and food habits, cooperation and coordination among these countries in establishing food composition data are essential. The objectives of this workshop, therefore, are to :

1. Review the status of food composition activities in the Arab Gulf Countries and the technical capacity to analyze, use and report on food composition information.
2. Discuss priorities for data review and data generation, together with the possible contributions from institutions in the Arab Gulf region.
3. Discuss the steps required to compile mutually acceptable databases, with potentially interchangeable data, in each of the presented countries.
4. Identify needs, including training needs, relative to developing and maintaining food composition programmes within a national and regional context, specify location and nature of need as well as specific groups in need.
5. Formulate recommendations and project proposals to promote the establishment and/or expansion of national food composition programmes, disseminate and exchange relevant data, establish standards, link with related programmes such as food control and food industry activities, and provide training.

We hope that this workshop will be a good opportunity for researchers and those interested in establishing food composition data bases to share their knowledge and experience in this important topic.

A. O. Musaiger
Chairman, Organizing committee

CONCLUSIONS AND RECOMMENDATIONS

OBJECTIVES AND NEEDS FOR FOOD COMPOSITION DATA BASES IN THE GULF

1. Determination of nutrient intakes for dietetic and public health programmes in the Gulf.

2. Conduct epidemiological studies of diet-related diseases.

3. Aid the formulation of nutrition and health education programmes, e.g. dietary guidelines, recommended dietary allowances.

4. Support food labeling and food regulation.

USERS AND USES

1. Dieticians and nutritionists.
2. Research scientists.
3. Food analysts.
4. Caterers.
5. Food manufacturers, distributors and retailers.
6. Legislators.
7. Health and agricultural policy makers.
8. Educators.
9. Media and the public.
10. Food consumption surveys and interpretation of food balance sheets.

A combination of food tables are used that include :

FAO (1982) : Food Composition Tables for the Near East. FAO, food and nutrition paper no. 26, Rome.

Gopalan, C., Rama Sastri, B. V. and Balasubramanian, S. C. (1981) : Nutritive Value of Indian Foods. National Institute of Nutrition, Hyderabad.

Holland, B. et al, (1992) : McCance and Widdowson's, the Composition of Foods. 5th revised edition. The Royal Society of Chemistry and Ministry of Agriculture, Fisheries and Food, London.

Kamel, B. S., and Allam, M. (1979) : Composition of Food Consumed in Kuwait (Phase I). Kuwait Institute for Scientific Research. Kuwait.

Musaiger, A. O. and Al-Dallal, Z. S. (1985) Food Composition Tables for Use in Bahrain. Ministry of Health, Bahrain.

Pellet P. L. and Shadarevian, S. (1970) : Food Composition Tables for Use in the Middle East. American University of Beirut. Lebanon.

Thomas, S. and Corden, M. (1977) : Metric Tables of Composition of Australian Foods. Australian Government Publishing Service. Canberra.

U. S. Department of Health, Education and Welfare (1972) : Food Composition Tables for User in East Asia. Bethesda. U.S.A.

QUALITY OF EXISTING DATA

1. Absence of documentation (source information) in some tables.

2. Information provided by food manufactures and distributors often lacks information on methods, sampling, etc.

3. Lack of information on commonly consumed traditional foods in the Gulf region.

4. Food tables are usually incomplete. Particularly lacking is information on dietary fiber, cholesterol, fatty acid profiles, components of carbohydrates, amino acids, and some trace minerals. These deficiencies are serious obstacles to research and educational activities on diet and disease.

DIFFICULTIES IN ACCESSING AND USING FOOD COMPOSITION DATA

1. Information is scattered, difficult to assemble, often incomplete and language barriers may exist.

2. Lack of standardization of terminology and nomenclature.

3. Lack of nutrient data on local foods

4. Inadequate documentation on sample origins and procedures and analytical methods.

5. Lack of routine availability of computer facilities, support and internet access.

6. Inadequate information on portion sizes, household measures and recipes.

7. Inadequacy of printed tables and lack of availability of computerized data bases.

BENEFITS OF REGIONAL COLLABORATION

1. Cost and time effective and sharing of resources (expertise, knowledge, labour, and facilities).

2. Possibilities for avoiding duplication.

3. Opportunities for countries to complement their national food composition data bases.

4. Opportunity for collaborative studies to improve quality and validity of food composition data.

5. Facilitate food trade and adherence to international trade guidelines and requirements.

6. Strengthen the scientific capacities of nutrition and food science departments and laboratories in the region.

7. Provide information needed for public health and agricultural food policy decisions.

OBSTACLES AND SOLUTIONS TO REGIONAL COLLABORATION

1. Food analysis and the development of food composition data bases is not a government priority in the countries of the region.

Solution : FAO, WHO and UNU should help government to recognize importance of supporting the development of reliable national food composition data bases.

2. Lack of coordination of food analytical activities and the development of reliable national food composition data bases.

Solution : Establish a regional center to coordinate the variety of initiatives required. Such a center would be expected to :

* Assemble all useful food composition data available for the region on both indigenous and imported foods in a form that makes them freely available electronically to all users.

* Coordinate the activities of such regional committees or task forces as may be established.

* Arrange for the convening of periodic regional meetings.

* Constitute an advisory group consisting of a representative from each of the participating countries and other as may be deemed.

CURRENT STATUS (Technical Issues)

Work is occurring within national research centers and universities, but food composition is not a government priority in any of the countries of the region. This lack of government policy is thus an obstacle to regional technical collaboration.

Technical issues in the region are driven by the fact that food composition efforts should concentrate on traditional and the most commonly consumed foods. As matter of policy, efforts should not be diverted to generating data for imported, processed and raw foods for which valid information is already available.

REGIONAL TECHNICAL GOALS

From the presentations and discussions it was evident that the countries of the region have many foods and recipes in common dishes and would benefit from free interchange of food composition data. It would also be help to have a joint effort for standardization of methodologies and the introduction of quality controls including the exchange of reference samples. However, to make maximum use of the possibilities for data interchange, there would be a need for consideration of differences in terminology and nomenclature and a joint effort to develop an interchange system that took these into account.

SAMPLING

1. Identification of traditional and commonly consumed foods in the region.

2. Criteria for deciding on what foods are common to the region and identification of commonality and variation in recipes for these dishes.

3. Harmonization of nomenclature and terminology of regional foods.

4. Criteria for recording sampling of ingredients, cooking procedures, preparation and storage of samples.

5. Compiling available data and ascertaining its quality.

6. It was also apparent that there was a great deal of similarity in the foods, dishes, recipes and menus within the region. Moreover, the countries of the region import a large propotion of their food supply from common sources.

7. There are compelling reasons for developing a capacity to exchange data among national food composition data centers in the region and with other data centers in the global INFOODS system.

METHODS AND QUALITY CONTROL

1. Specify nutrients for which analytical data are needed.

2. Identify and harmonize analytical methodologies for priority nutrients.

3. Identify possibilities for specialization of some laboratories in the region on certain nutrients or groups of nutrients.

4. Develop regional mechanisms for quality assurance including criteria, protocols, method validation and proficiency tests involving standard reference materials.

DATA MANAGEMENT

1. Adopt, modify, adapt or develop appropriate data management systems.

2. Promote networking of data base within the region.

3. Specify what is actually measured and how by the use of standard INFOODS tagnames, creating additional tagnames when required.

RECOMMENDATIONS FOR THE TECHNICAL ISSUES

1. Establish a Committee for sampling to include not only analysts and statisticians but also food prepares, dietitians, and nutritionists.

2. Establish a multidisciplinary committee for Methods and Quality Control.

3. Establish a multidisciplinary committee for Data Management.

4. FAO, WHO and UNU should help governments to recognize importance of supporting the development of reliable national food composition data bases.

5. Limit food composition tables to nutrients as opposed to contaminates .

6. Regional coordination should include the pursuit of support from potential donors through the preparation of a proposal for food composition activities.

ORGANIZATION

1. **Regional secretariat** : It is proposed that a regional coordinating secretariat be established in the Department of Food Sciences and Nutrition, UAE University for the Arab Countries of the Gulf.

2. **National committees** : Each country should form a national committee concerned with food analysis and food composition in support of GULFOODS activities that includes all sectors involved in food analysis and the use of food composition data including government laboratories, university department, research laboratories and the food industry. Each national committee should designate a national coordinator or focal point.

REGIONAL COMMITTEES

1. A Committee on training will be expected to identify, promote or provide facilities for essential training in the analysis of the nutrient content of food and the establishment of food composition data bases and tables. Skills need include expertise in representative sampling, proper sample handling, accurate and precise nutrient analyses, analytical methods, and quality control procedures.

Priority will be given to :

a. Further instruction in the use of INFOODS TAGNAMES, nomenclature guidelines and other data management and organization procedures.

b. Training for sampling and documentation, sample handling, analytical methods and quality control training.

2. A committee on food terminology and nomenclature will need to review existing systems and determine the feasibility of harmonizing them. This will include :

a. Establishing a set of minimum criteria to include Arabic name, local name if different, English name, scientific name and food photo or image.

b. Reviewing existing systems to determine feasibility of linking data

c. Cooperating with the INFOODS-IUNS Committee on Terminology and Nomenclature.

3. A Committee on Sampling and Sample Documentation :

Food Samples for analysis must be representative of foods consumed by the population of the country or province. Representative food samples are important to increase the validity of food composition data. Guidelines for food sampling are required for the development of standard procedures. It will be necessary to :

* Establish guidelines for collecting representative food samples.

* Provide standard procedures for collecting representative samples of foods of the region and monitor their implementation.

* New foods, functional foods and processed foods are being continually introduced. Standard sampling procedures need to be revised and modified so that representative food composition data can be generated. It will be necessary to establish a minimum set of criteria for documentation of food samples.

4. A Data Handling Committee will be responsible for a series of data handling issues that include (1) component identification (i.e., tagnames), (2) data capture and documentation, (3) rules for importing data, and (4) criteria for evaluating existing data.

5. Provision of Standard Samples - The group accepted with appreciation the suggestion that the Nestle Research Center in Switzerland would make available standard samples for laboratory quality control in the region.

FUNCTIONS OF THE SECRETARIAT

1. The secretariat will be responsible for assembling all useful food composition data available for the region on both indigeous and imported foods in a form that makes them freely available electronically to all users.

2. It will coordinate the activities of such regional committees or taskforces as may be established.

3. It will arrange for the convening of periodic regional meetings.

4. It will convene or consult an executive committee consisting of the chairman of each national committee and others as may be deemed desirable.

5. It will solicit contributions from industry, foundations, and agencies for a fund in support of GULFOODS activities to be used for facilitating periodic meetings, training courses and publications. Funds will be administered by the secretariat with the approval of the executive committee.

FUNCTIONS OF THE EXECUTIVE COMMITTEE

1. It will be consulted on policy initiatives between the periodic meetings of the entire organization.

2. It will approve use of funds contributed for GULFOODS activities.

3. It will determine the appointment of chairman and members of the regional committee.

EXTERNAL SUPPORT

In concluding the meeting, participants recognized that a fully functional regional system would take several years to achieve. They requested the INFOODS secretariat to provide recommended approaches and documents for the assistance of GULFOODS working groups to ensure that regional activities would be harmonized to the extent possible with those of other INFOODS regions. They also called upon FAO and UNU to provide advice and assistance in achieving its objectives and to communicate to government authorities in the region the importance of food composition activities and of establishing national committees for stimulating national efforts and cooperating with the GULFOODS initiative.

ACTION PLAN

1. Establish immediately a secretariat and regional data center in the Department of Food Sciences and Nutrition, UAE University, Al Ain, UAE. The secretariat will provide in one month an inventory of regional institutional resources for the generation and utilization of food composition data.

2. Within six months each country will be expected to establish a National Committee for GULFOODS.

3. Within six months the Executive Committee will be established.

4. The recommended regional committees will be organized as soon as the executive committee has been established and has an opportunity to determine the composition.

5. UNU/INFOODS secretariat will begin to provide the secretariat with technical advice and guidance as soon as internet contact is established with the secretariat.

6. Within six months terms of reference of a GULFOODS fund will be drawn up and after approval by the Executive Committee, contributions will be solicited.

7. Within six months a Newsletter will be initiated.

8. Within one year an initial computerized regional food composition data base will become operational.

9. As soon as the data base is judged adequate, a provisional Food Composition Tables for the Region will be printed out.

10. Within the first year arrangements will be completed for a second regional meeting for GULFOODS.

FAO PERSPECTIVE ON INTERNATIONAL FOOD COMPOSITION ACTIVITIES

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The importance of food composition data has long been recognized by the United Nations. When the Food and Agriculture Organization of the United Nations was established fifty years ago, data on food composition immediately began to play a role in the Organization's activities. The early development of the World Food Surveys was linked to such data, and, over the years, FAO support for agricultural planning and production has relied on knowledge about the nutritional value of foods. Moreover, data on food composition have always been crucial when providing assistance to governments that are determining the nutritional status of their people .

In 1949 FAO issued its first set of food composition data, the "Food Composition Tables for International Use." The Organization went on to prepare regional food composition tables for Asia, Africa, the Near East, and Latin America as well as tables on vitamins, minerals, and amino acid patterns in foods. FAO reduced its work in this area in the late 1970s upon completion of the series of tables for the developing world, but these publications continue to be widely used.

Now, international food composition activities are again receiving attention. We are faced with newer and expanded uses for data. At the same time, the long-standing importance of food composition information in formulating policies and programmes to improve nutrition continues, -- and was recently re-emphasized by the International Conference on Nutrition, held in Rome in December 1992.

In recognition of the need for renewed and collaborative food composition work, FAO and the United Nations University have established a close working relationship. The joint effort builds on the global UNU/INFOODS network to generate, compile, and disseminate food composition data, INFOODS, or the International Network of Food Data Systems, has worked during the last 10 years to establish regional centres and provide technical support for food composition data generation and dissemination.

Renewed efforts to promote food composition activities and programmes must take into account the traditional and still critical uses of food composition data that include evaluating the adequacy of diets and investigating diet/health relationships. But they must also consider the emerging, broader applications of food composition data. There is unprecedented opportunity for wider support for food composition work ranging from the food industry to consumer groups. Consumers in all countries want more

detailed information about the nutritional value of foods, and these interests have led to sweeping legislation to require nutrition information for foods. Food manufacturers have responded to this interest by seeking new formulations of foods consistent with current health recommendations, an activity that also requires information on food and ingredient composition.

At the same time, the global nature of food processing and the anticipated expansion of world food trade as a result of new trade agreements increase the likelihood of greater food trade and more exchange of foods and ingredients across international borders. This, in turn, stimulates the need for food composition data for labelling, regulatory, and other purposes related to such trade and exchange. International organizations such as FAO and the UNU can assist in the development of programmes and guidelines for such activities.

FAO objectives take into account the fact that food composition work can be expensive, especially in developing countries or countries in transition where budget constraints can be particularly acute. FAO supports regional collaboration in order to reduce costs as the need for data expands. At the same time, the Organization believes that such cooperation is best accomplished when effective national capacities are set in place, and we will promote national food composition programmes in a variety of ways.

First, from the operational point of view, a broad approach to the potential uses and users of food composition information is needed as national programmes are established and strengthened. An endpoint that focuses only on highly sophisticated data management systems may not meet the requirements of many users in developing countries where such data systems are difficult to operate over time. Therefore, a mix of information collection, processing, and dissemination systems will be necessary over the next several years.

Accurate data are needed to show associations between food and nutritional status and to design interventions, meet regulatory standards, properly label food, and assist in product formulation. However, it is critical to balance the generation of new food composition data against costs because resources are very limited. The specific need for and use of any new data, together with the costs to achieve the required data quality, should be examined.

As national food composition programmes are initiated and strengthened, linkages to existing and complementary systems should be encouraged. Specifically, there are clear resource benefits to link such programmes as much as possible to ongoing food control system activities, including laboratory facilities. This is especially true where materials and human resources are limited. In many instances the generation of food composition data is considered to be a research function limited to universities and research institutions. However, in many developing countries such institutions are often poorly equipped and founded, while food control systems are relatively well established and often have wide technical expertise available. FAO has provided

significant levels of assistance to food control programmes over the years and much of this capacity can be utilized for food composition work and represents an important resource in strengthening food composition programmes.

At the national, regional and international level, increased coordination and standardization is necessary to harmonize the different systems dealing with food composition data in order to improve sharing of data. Compatibility of databases is essential to reduce the expenditures associated with generating and maintaining the composition data on a global basis and to assist the developing countries in lessening the costs of producing reliable food composition data.

As for FAO activities, we anticipate a regional model for action, a model that allows local control of food composition activities and promotes direct working relationships. It is based on communication and quality control and has the goal to generate, disseminate and promote the use of high-quality food composition information by a wide range of practitioners, researchers and policy-makers. Overall, the model should (1) promote the generation and distribution of data; (2) provide for the establishment and revision of standards and criteria; and (3) provide representatives that will establish procedures and priorities.

FAO, in revitalizing its working in food composition, will fulfil a coordinating and training role. The Organization is well positioned to function in this capacity for several reasons. FAO has the United Nations mandate for activities that span all sectors related to food at the international level and include food trade, food quality, and the international food standards known as the Codex Alimentarius. Just as importantly, FAO has an established system of communication with national governments and regional agencies, and is well versed in shaping actions on interdisciplinary problems which require an open forum to find solutions.

To assist countries and regions in accomplishing these important activities, FAO intends to :

1) Promote and expand activities at national, regional and international centers in order to increase analytical capacity, including linkages with food control programmes;
2) Assist in formulating standards for terminology, sampling procedures, sample handling, analytical methods and data quality checks that will make a network more compatible and harmonious across regions;
3) Promote dissemination and appropriate use of data; and
4) Promote training to strengthen and sustain institutions and individuals.

Currently, FAO supported regional meetings are being held jointly with UNU/INFOODS to identify needs relative to strengthening national data generation programmes and to encourage regional collaboration and linkage with food control activities. Obstacles to work and collaboration are also being identified.

Workshops have recently been held in Anglophone Africa, Eastern Europe, and

Francophone West Africa. Today we are meeting in the Gulf region, and we have just finished sessions in South America and China.

The main issues identified at the Anglophone Africa workshop were associated with inadequate laboratory facilities, lack of trained personnel and lack of funds. Also, the insufficient technical capability to operate food composition databases was emphasized. Another major concern was the lack of awareness among decision-makers of the importance of food composition data. In many instances, this was the main reason for the lack of policies and financial support. The issues of communication with decision-markers were also identified at the Francophone Africa workshop. However, in the case of this regional meeting, many examples of food composition programmes providing data for exporters were identified. When fee-for-service activities were used they often sustained and strengthened the entire analytical programme. It also emphasized the potential interface between food industry, food control, and food composition programmes. In addition, training and equipment were highlighted as key factors, as was the need to agree upon and establish harmonized management strategies. The Eastern European workshop also focused on the need for common procedures for generating and describing data, and called for training updates for both staff and managers.

FAO has done a range of work related to food analysis and sampling strategies in the context of building capacities for improved food quality and safety. Manuals and guidelines developed by the Organization cover the topics of sampling methods, establishing food control laboratories, chemical analysis guidelines for contaminants and for adulteration, and protocols for microbiological analysis. In addition, FAO has published and distributed a manual on laboratory quality control and guidelines for developing an effective national food control system.

For food composition, FAO is now producing a guidelines manual to be used in establishing food composition programmes in developing countries. The manual is a guide to initiating and sustaining both analytical activities and management. Therefore, the target audience is technical staff as well as policy-makers and administrators in developing countries where systems for generating and using data need initiating or strengthening and where resources are often very limited. The manual will emphasize linkage of local objectives for food composition to appropriate strategies and methods.

Longer term plans for FAO involve providing assistance in formulating and applying guidelines on terminology, sampling, analytical methodology, and data quality to ensure accurate data and to make data more compatible across regions. FAO also intends to promote training opportunities as well as cost effective generation, dissemination and appropriate use of data.

We will conclude by saying that there is much work to be done in the face of diminishing resources. At the same time, the opportunities for expanded support have never been greater. We must face these challenges and opportunities in efficient and collaborative ways.

BACKGROUND, DEVELOPMENT AND FUTURE OF THE GLOBAL INFOODS NETWORK

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Introduction

In the 1940s and 1950s interest in the generation of representative food composition data led to the publication of a Regional Food Table for Latin America in 1961 that was developed by an FAO consultant working with the Institute of Central America and Panama (INCAP). FAO went on to publish food composition tables for Asia in 1972, for Africa in 1968 and for the Middle East in 1970, although the available data were fewer and less reliable than for Latin America. Soon afterwards, FAO phased out its work on food composition and there have been no new regional food composition tables for 20-30 years, except for a table for the Near East published by FAO in 1982, until the INFOODS sponsored Food Composition Table for the Western Pacific was published in 1995.

In January 1983, a group of individuals met in the Rockefeller Conference and Study Center in Bellagio, Italy, organized by the United Nations University with participation of FAO and WHO. Its purpose was "to explore the needs for, and the limitations of, food composition data bases, and to propose what was needed (Rand and Young, 1984). Out of this conference came the design and scope of an international network to be designated as INFOODS that would "promote international cooperation in the acquisition and interchange of quality data on the nutrient composition of foods, beverages and their ingredients in forms appropriate to meet the needs of government agencies, nutrition scientists, health and agriculture professionals, policy makers and planners, food producers, processors and retailers, and consumers".

The conference identified the more important aspects of INFOODS as: 1) a network of regional data centers, 2) an organizational administrative framework for various expert task forces, 3) the generator and repositor of special international data bases, 4) the stimulator of national data base programmes, 5) a general and specific resource for persons and organizations interested in food composition data on a worldwide basis.

The executive summary of the conference report emphasized series of specific recommendations to the United Nations University that have been wholly or partially implemented to a remarkable degree, considering the limited resources that have been available. These include the following :

Establishment of an International System

The first and most fundamental recommendation was to set up an international organization of standards and guidelines for collection, compilation, and reporting of

food component data with the aim of establishing and coordinating a worldwide network of regional/national data centers directed toward the generation, compilation and dissemination of accurate and complete data on food composition.

UNU accepted responsibility for administering INFOODS and, in addition, support was received for three years from the U.S. National Cancer Institute. With the combined support INFOODS established a secretariat and developed the necessary software for the storage of food composition data and its interchange among data bases. Through a UNU sponsored IUNS committee it was able to ensure the completion of four key publications :

1. Food composition Data. A Users Perspective. United Nations University, Tokyo 1987 (Rand et al., 1987)

Based on a conference in Logan, Utah in March 1985, this volume presents the views and experiences of prominent workers in the first concerning the importance of food composition data, current problems, and what must be done to improve the situation. It provides an essential introduction and survey for anyone interested in, or expecting to be involved with gathering, compiling, and using food composition data. It emphasizes the ways in which food composition underpins research and policy in important areas of public health, dietetics, nutrition and epidemiology as well as being critical for the food industry and key decisions made by bilateral and international assistance agencies. It is a useful reference for university courses on food and nutrition.

2. Compiling Data for Food Composition Data Bases (Rand et al., 1991)

Food composition data have been compiled into many data bases throughout the world. As the uses of these data increase, larger numbers of individuals and organization become involved in the compilation, and thus the need for guidelines on the gathering, formatting, and documentation increases. This document describes and presents recommendations for the procedures involved with compiling the values for food composition data bases. Specifically addressed are the five major ways to obtain data on the nutrient content of foods including :

* direct analysis based on analytical measurements,
* calculated as representative values (e.g., weighed means of several samples),
* gathered from other sources (e.g., taken from other tables or the literature),
* estimated from similar foods (e.g., substitution of data),
* estimated from ingredients (e.g., recipe calculations).

3. Identification of Food Components for Data Interchange (Klensin et al., 1989)

The effective use of food composition data requires the precise identification of the nutrients and other food components actually measured. Common names for food components are often applied to a variety of methods of analysis, or combinations of chemicals that can results in different quantitative values of the same food. This book provides the first comprehensive standardization of nomenclature for international

nutrient data exchange. It sets out a straightforward set of rules for identifying food components precisely and constructing data bases suitable for transfer between computers.

4. INFOODS Composition Data Interchange Handbook (Klensin, 1992)

This volume is the fourth in the series that provides information and guidelines about requirements for food composition data, the identification of nutrient and non-nutrient components of foods, the computer representation and accurate interchange of food composition data, and on the organization, compilation, and content of food composition tables and data bases. It presents the structure and rules for moving data files between countries and regional organizations in a way that preserves all of the information available. The approach also alerts the developer of data bases about potential areas in which ambiguities are likely and that special care should be taken to identify mechanisms for the improvement of overall data base quality.

The key to the interchangebility and accessibility of the INFOODS system in developing countries is the universal use of these specifications, referred to as "Tagnames". They are quite flexible and allow any number of additional nutrient tags and qualifiers to be added. Adoption of these by industrialized country data bases will greatly facilitate the global interchange of such data. This should be one of the recommendations of this meeting.

Establishment of an International Journal of Food Composition

The Bellagio meeting also urged investigation of the "feasibility of establishing an international journal devoted to food composition studies". It was felt that such a journal would facilitate adoption of guidelines by the scientific community, serve as an information source for any future revision of the guidelines and provide a means for dissemination of the findings and critical reviews in all areas of food composition. In 1987 the United Nations University established the Journal of Food Composition and Analysis as a co-publication with Academic Press, with Dr. Kent Stewart as the editor, appointed by UNU with concurrence of Academic Press. This journal, now in its eighth year, publishes new food composition data as well as information on new and improved methods.

Directory of Existing Food Composition Data Bases

Another recommendation was compiling a "global survey of existing data bases and ongoing data collection efforts". A listing of all available data bases has been compiled and distributed. It is now being maintained in the INFOODS secretariat server and can be accessed by e-mail.

Recommendations for the Construction and use of Food Composition Data Bases

Also proposed at the Bellagio meeting was examination of the entire area of data gathering, with sampling, assay and quality control of special interest. An important

aspect of this activity should be examination of the problems of evaluating data in the literature and other sources as well as the critically important question of establishing quality criteria for accepting data into a food composition data base.

To facilitate the implementation of this recommendation UNU provided support for Dr. Heather Greenfield to work Dr. David Southgate to author **Food Composition Data, Production, Management, and Use** published in 1992 (Greenfield and Southgate, 1992). This volume systematically and authoritatively covers the initiation and organization of a food composition data programme, the selection of foods and nutrients including sampling, choice of analytical methods, quality control, conventions and modes of expression of data and guidelines for use. It is an essential companion to the other INFOODS manuals described above.

Systems of Nomenclature and Coding

A specific recommendation was "establishing nomenclature and a system of coding that will include defining and recommending terms for identifying foods and components, units of expression, analytical methods, references, locations, environmental conditions and other as necessary". A UNU-IUNS Committee, chaired by Stewart Truswell, developed a document that was reviewed at a meeting in Copenhagen in July, 1987 and published as **INFOODS Guidelines For Describing Food : A Systematic Approach to Describing Foods to Facilitate International Exchange of Food Composition Data** (Truswell et al., 1991).

This report is based on extensive international consultations and is intended to be culture independent. It presents the INFOODS guidelines for describing foods with the intent of facilitating interchange of food composition data between nations and cultures by compiles of nutrient data bases. Familiarity with the system is useful in other areas of nutrition, e.g., in recording food intakes. The system is a broad, multifaceted, and open-ended description mechanism using a string of descriptors. Criteria are proposed for deciding whether a food is "single" or "mixed" (multi-ingredient), and different set of descriptive facets are provided for these two classes of foods. Because of the complexity of this topic when many different languages and cultures are involved, these guidelines were re-examined by a working group that met in June, 1995. It identified a series of additional issues that will require a revival of an UNU-IUNS committee on Terminology and Nomenclature to deal with them.

Establishment of Regional INFOODS Data Bases

The next recommendation of the INFOODS Bellagio meeting was to "make contact with relevant individuals and organizations around the world in order to involve them in the INFOODS initiative in cooperation and close consultation with FAO and WHO".

Following the Bellagio meeting, initial organizational meetings were held in Copenhagen in 1984 for EUROFOODS (West, 1985), in Guatemala in 1984 for LATINFOODS (Bressani, 1987) and in Fiji in 1986 for OCEANIAFOODS (English and Lester, 1987). Countries participating in the various regional INFOODS networks are shown in Table 1.

By the time of the second meeting of LATINFOODS , in Chile in November 1988, most countries in the region had formed their own food composition committees adding "FOOD" to the country name with the most active groups being CHILEFOODS. AGRENTINAFOODS, BARZILFOODS, VENEZUELAFOODS, and BOLIVIAFOODS. At the meeting Ricardo Bressani, the chairman of LATINFOODS, presented a standard form for recording sample information and analytical data that all of the member countries agreed to follow. He also initiated an exchange of comparison food samples for quality control. A third meeting of LATINFOODS was held in Costa Rica in 1990, a fourth in Puerto Rica in 1991, and a fifth in Caracas in 1994.

The Organizational structure and activities as well as the food composition data base of ASEANFOODS should be particularly useful for the development of MASIAFOODS. Locally initiated ASEANFOODS network activities include :

* Development of sampling guidelines for food composition tables. This activity is shared by the national coordinator of the Philippines, Dr. Aida Aguinaldo. An ASEAN guideline of food sampling for food composition table development will be formulated and distributed to the national coordinators for comment. Subsequently, the final guideline was presented in the ASEAN Workshop 1994 and distributed to the member countries.

* Documentation of analytical methods used in ASEAN. This activity is shared by the national coordinator of Malaysia, Dr. Tee E. Siong.

* ASEANFOODS proficiency testing. The collaborative testing for quality control of food analysis laboratories among ASEANFOODS laboratories has been under the responsibility of the national coordinator of Thailand, Dr. Prapasri Puwastien. At present, two food samples, soybean flour and rice flour, are available.

* Preparation of an operating manual and updating the ASEANFOODS food composition database and interchange system. An operating manual for using the ASEANFOODS database and interchange system based on recommended INFOODS procedures has been adopted.

In 1992. INFOODS received funds from UNU for the purchase of hardware and for training in the use of appropriate software for the regional data bases of ASEANFOODS in the Institute of Nutrition of Mahidol University (INMU) in Bangkok, and OCEANIAFOODS in Fiji under the South Pacific Commission. A grant from the Pew Charitable Trusts in 1993 provided for the same development of subregional databases for LATINFOODS in the Institute of Nutrition of Central America and Panama (INCAP).

The regional data bases in Bangkok and Guatemala became functional in 1993 and the one for South America in the Institute of Nutrition and Food Technology (INTA) in Santiago, Chile in 1994. A regional data center is being established in Fiji for the Wester Pacific. Eastern European countries are part of EUROFOODS although not all of the former CIS countries are yet actively involved. A regional INFOODS grouping for South Asia (SAARFOODS) is also being organized.

Development of Data Base Management Systems

The essence of a regional food composition data center is not just the accumulation of regional data in a central location. In fact with the INFOODS data interchange system and internet communications, national data can be equally well be maintained in national data bases unless there is a desire to pool data for a printed regional food composition table. Otherwise, each national data base can be maintained with all useful data from other countries sand regions and printed out in national food composition tables as desired.

It is more important to develop the regional cooperation for purposes of interlaboratory comparisons and standards development and agreement on guidelines for terminology and nomenclature, and possibly additional tag names specific to the region.

The key to the interchangability of food composition data among data bases is the uniform use of INFOODS tag names. To use carbohydrate as an example. US, UK, SE Asia and Australia all use them term "carbohydrate' but each means something different by it. The U.S. includes fiber, Australia refers to available carbohydrate excluding fiber, the UK expresses available CHO in monosaccharide equivalents and Australia describes available carbohydrate but not in monosaccharide equivalents. This can result in dramatic differences in values. For examples, as shown in Table 2, the value for carbohydrate in wheat bran expressed as dry mater can range from 40 to 75 g/100g. For maize, the range is from 85 to 93 g/ 100g. This depends entirely on whether or not it is expressed in monosaccharide equivalents. At least five different tag names are required for carbohydrate and for retrospective data it is often necessary to use a tag name for method unknown.

For fiber, there must be many different tag names because this refers to so many different things and methods and each must be identified with an appropriate tag name. Some methods are very imprecise and this is identified by the tag name. There are similar problems with different methods of identifying most of the other nutrients and food components.

Partnership with FAO

For its five years the INFOODS secretariat had substantial support from the U.S. National Institute of Health, which made possible the series of committee meetings and publications described above, while UNU funds supported the gradual development of regional INFOODS activities. Since the UNU has continued with limited resources to maintain the momentum of regional network development. Fortunately when John Lupien became the Director of the Nutrition and Food policy Division he renewed the interest of FAO in the food analysis capabilities of developing countries and arranging for an update of the food composition tables published by FAO in the 1970s and still in demand. This soon led to joint sponsorship of the INFOODS programme and since then a number of joint FAO/UNU meetings. In addition to consultation meetings in Rome in 1993 and Tunis in 1994, these have included the organizational meeting for AFROFOODS in Beijing, China and GULFOODS in UAE. Organizational meeting to

cooperation in the INFOODS networks, FAO is supporting a variety of related activities in the INFOODS networks, FAO is supporting a variety of related activities in support of generating and using better using better food composition data as publication "Food, Nutrition and Agriculture" (FAO, 1995)

Training Activities

UNU has provide fellowships for to two years training in Food Analysis at the University for New South Whales in Australia and combined training in the Agricultural University, Wageningen, Holland and the Food Analysis Laboratory, Norwich, England or the Food Research Institute, Tsukuba, Japan. In 1994, a six-week course in food analysis and food data base management in Wageningen was partially supported by FAO and UNU as is a similar course in Santiago, Chile in 1995. This course will be repeated in Wageningen in 1996 and probably also in Asia.

Concluding Remarks

The ultimate goal of INFOODS is to have every country in the world associated with a regional data base that can supply them with food composition data and assist them to develop national data bases adapted to various uses. When INFOODS was started in 1984, it was assumed that funds would be required to purchase a VAX or other high capacity computer for each regional data base, but today personal computers have greater capacity than the 1980s VAX and individual country data centers as well as regional data centers can directly access each other through the internet. The task ahead is to complete the netwrok of regional data centers and networks and gradually extend their capacity to include all participating countries. As the regional network with the largest proportion of the world's population. GULFOODS has a significant role to play in the global INFOODS efforts.

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Table 1. Global Organization of INFOODS

INFOODS Secretariat: c/-Crop & Food Research
Private Bag 110030
Palmerston North, New Zealand

AFROFOODS

ECSAFOODS - Botswana, Eritrea, Ethiopia, Kenya, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, Somalia, South Africa, Sudan, Swaziland, Tanzania, Uganda, Zimbabwe

NAFOODS - Algeria, Libya, Mauritania, Morocco, Tunisia

OCAFOODS - Angola, Benin, Burkino Faso, Burundi, Cameroon, Cap-Vert, Congo, Cote D'Ivoire, Djibouti, Gabon, Guinee, Guinee-Bissau, Guinee-Equatorial, Madagascar, Mali, Niger, Republique Centrafricaine, Rwanda, Saoy Tome y Principe, Senegal, Tchad, Togo, and Zaire

WAFOODS - Gambia, Ghana, Liberia, Nigeria, Sierra Leone

ARABFOODS - Egypt, Iran, Iraq, Jordan, Lebanon, Palestine, Syria,

ASEANFOODS - Brunei, Cambodia, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand, Vietnam

EUROFOODS - Countries of Eastern and Western Europe

GULFOODS - Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates

LATINFOODS

South America - Argentina, Aruba, Bolivia, Bonaire, Brazil, Chile, Colombia, Ecuador, Peru, Surinam, Uruguay, Venzuela

Central America - Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama, (Cuba, Dominican Reqpublic)

MASIAFOODS - China, Hong Kong, Korea, Taiwan

NORAMFOODS - Canada (Haiti), Mexico, United States

OCEANIAFOODS - American Samoa, Australia, Cook Islands, Fiji, French Polynesia, Marshall Islands, Micronesia, Nauru, New Zealand, Niue, Palau, Papua New Guinea, Solomon Islands, Tuvalu, Vanuatu, Venda, Western Samoa

SAARCFOODS - Afghanistan, Bangladesh, Bhutan, India, Iran, Maldives, Nepal, Pakistan, Sri Lanka.

Table 2. Terms and Meanings Associated with Carbohydrate Values in Food Composition Tables

Country	Term used	Expanded description	Tagname	Standardized value for wheat bran (dry matter basis)	Standardized value for corn flour (dry matter basis)
USA	Carbohydrate, total	Total carbohydrate by difference (including fiber)	<CHOCDF>	75 g/100g	85 g/100g
UK	Carbohydrate	Available carbohydrate in monosaccharide equivalents	<CHOAVLM>	42 g/100g	93 g/100g
East Asia	Carbohydrate	Total carbohydrate by difference	<CHOCDF>	75 g/100g	85 g/100g
Australia	Carbohydrate, total	Available carbohydrate (not in monosaccharide equivalents)	<CHOAVL>	40 g/100g	85 g/100g

Appendix

Electronic addresses for accessing INFOODS information

FOOD-COMP@INFOODS.UNU.EDU (Internet)

FOOD-TAG@INFOODS.UNU.EDU (Interntet)

LISTSERVE@DB0TUI11 (Bitnet)

WWW.CROP.CRI.NZ

FOOD COMPOSITION ACTIVITIES IN THE NEAR EAST REGION

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Introduction

The term Middle East or Near East are often used without any clear definite connotation of the territorial limits involved. There has been never a general agreement on their precise meaning and the countries to be covered. The FAO Near East Region included for discussion in this paper comprises 26 countries (20 Arab countries which are members of the Arab League) in addition to six non-Arabic speaking countries, which are Turkey, Iran Pakistan, Afghanistan, Cyprus and Malta. The FAO food composition tables for the Near East which were published in 1982 referred to 22 countries, since the 4 other counties were not members of the FAO Near East Office. This means that data from the 22 countries are included, however, very limited information was available regarding the Arab countries of the Gulf as well as Mauritania, Yemen and Djibouti.

The region under consideration sits astride the lines of communication with Europe, Africa and West Asia, and it has been as a result, subject to influences in terms of their food habits from the East, West, North as well as the South. The total land area of the Near East Region is about 16.5 million Km2 out of which 75% is desert, 20% is range and forestry and the remaining (5%) is used as arable land and for permanent crops. The total population of the regions is about 500 millions. The region is characterized by the highest population growth rate in the world of 3.1% (population will double within 23 years), this is coupled with a high rate of urbanization of 4 to 6%. The region has the poorest and the richest countries of the world. Most of the countries of the Near East have a negative food trade balance, with the exception of Turkey. The food import in the Near East Region is estimated to be 20 billion US Dollars. This represents 10% of the World Food Trade. All these factors contribute to the high degree of variation in the type of foods available for consumption.

Food Composition Activities in the Near East

Food and nutrition activities in the Near East have always followed world trends. In the early thirties, two important events happened in the world. The first was establishing the dietary requirements for health, and the second was the discovery of widespread malnutrition in the most advanced countries. The pioneering study was prepared by Johan Boyr Orr (who became later the first Director General of FAO) showed no less than one-third of the population of Great Britain was malnourished, mainly because of inadequate consumption of milk, vegetables and fruits. His findings and conclusions were associated with the interpretation of dietary intakes using food composition tables. Research on dietary requirement and food consumption was always associated with

the interpretation of dietary intakes using food composition tables. Research on dietary requirement and food consumption was always associated with food composition tables.

In Egypt the National Food and Nutrition Committee was created in 1939 to assess the dietary habits of the Egyptian population and to recommend necessary action. The Committee carried out the first food consumption survey in villages in Lower and Upper Egypt on a relatively small sample size. The results of the survey showed low intake of calories and protein. These findings were extremely helpful in the establishment of the Ministry of Supply and Internal Trade and the introduction for the first time of a food rationing system. The second function of this newly-established Ministry was the fixation of prices of basic food commodities (these different actions were what we call now a practical approach to household food security). It should be noted that Egypt issued the first laws on adulteration (especially of food) in 1941. The implementation of the laws called on the establishment of food standards which were based on the food composition and analysis.

FAO was founded in 1945, one of its first tasks was to prepare a survey on current information on the world's food problems. FAO published its first world food survey in 1946, which covered 70 countries comprising 90% of the earth population. The survey was pioneering in analysing the world food situation. It drew the attention to the degree of malnutrition based on food availability, nutritional requirement and purchasing power. The result of the survey proposed nutritional targets for intake of the main food groups, and calculated country by country the increases in food production and consumption that would be needed to attain them. Such a survey could not be achieved without information on the composition of foods produced, and consumed. The main weakness of the result of the survey was that much information on certain traditional or wild plants and animals which are consumed in certain parts of the world; mainly Africa, the Far East and Latin America was not known in terms of their composition and nutritional value. This drew attention to the need for food analysis and preparation of national and later, regional food composition tables. Also food composition tables were needed for the preparation of the Food Balance Sheet which at that time was necessary to give an estimation of food availability, dietary habits and nutritional requirement for several countries. The Food Balance Sheet was helpful also in examining the food gap and the trend in consumption. All these activities were extremely useful in spite of the limitation of available information.

It should be also noted that the FAO Regional Office for the Near East was established in 1949 with a Regional Representative and a Regional Nutrition Officer. The fact that the first technical officer in the Near East Office was a nutritionist clearly demonstrated the importance of nutrition in the Near East Region in that period. Manpower development in the different aspects of the nutrition field was a main task of FAO in the Region and accordingly the first regional training center for the training of professional staff was organized in 1950. FAO assisted some countries for the creation of a National Institute for Nutrition; the first was in Egypt in 1950 and later the National Institute of Nutrition in Iraq in 1954. The main task of these institutions was the assessment of the nutritional situation and dietary habits. Food analysis were extremely helpful in the interpretation of the data of these surveys. Each institute has at that time an active food analysis laboratory.

Also during the fifties and early sixties, several countries in the Region which had just gained their independence, implemented large nutrition intervention programmes, mainly school feeding programmes coupled with nutrition education. Food composition tables were used as an essential tools for the implementation of these programmes.

During the sixties, Tunisia started its first national food consumption survey. The data could not be analyzed without a food composition table. This was based on the analysis of certain foods for certain nutrients. The remaining data was obtained from other sources outside the region. Similar surveys were carried out later in Algeria, Morocco and other countries.

During the same period, with the high increase in urbanization, many of the traditional foods such as Harissa (hot spice sauce) commonly consumed in North Africa were processed through the food industry. There was a need for its analysis for the establishment of a food standard. Tehina in West Asia and Halawah were also traditional food which came on the market after they were processed. During the seventies, with the rapid economic growth due to the increase in price of oil, the region witnessed a large population migration within and outside the region, especially from Asia. The immigrants came with their own food habits and influenced the food consumption patterns in the region, especially in the Arab Gulf Countries. Also fast foods became very popular. With the increase in income in several countries of the Near East and the open door policy (Economic Reform) for the free import of foods without taxation, food in its different forms from all over the world was introduced in the Near East.

FAO activities in Food Composition Tables

The First FAO food composition tables were published in 1949. The food composition tables for Latin America were published by INCAP in 1961. FAO published the Regional Food Composition Tables for Africa in 1968 and for Asia in 1972. In the early seventies, the American University of Beirut published Food Composition Tables for the Middle East. The title is misleading since the data included an analysis of Lebanese foods which are also consumed in Jordan and Syria. It was an extremely useful publication. The FAO regional office for the Near East, in cooperation with the FAO Food Policy and Nutrition Division (ESN), collected published and unpublished food composition data from different institutions and individuals in the region. These data were compiled and published by FAO in 1982 as "Food Composition Tables for the Near East". This publication was translated into Arabic in 1988. In spite of the usefulness of this publication it covered a limited number of foods, limited nutrients, and in some cases the methods used for certain analysis are no longer valid. The sampling techniques were not specified and actually the analysis of most of these foods was generally for meeting specific purposes.

Need for a Food Composition Data for the Near East

This area needs great emphasis, attention and should receive greater priority. Consumers in most of the Near East countries are demanding more information on the food they

consume. They are more aware of fat, cholesterol, sugar, fiber, pesticide residues, and additives. They are concerned with food contamination and food labeling. With the expansion of food industry in several countries of the region, the processing of some traditional foods, the development of new food formula, the increase in food import, and the promotion of food export, the need for food analysis to meet the local and the international market, becomes of great economic importance. Furthermore, FAO technical assistance for the strengthening of the food control system in most of the countries of the region has given special attention to the upgrading of food control laboratories in terms of equipment and training of personnel. It should be noted that on the other hand, the issuing of food laws, and Codex standards was very limited and lags behind. Codex Alimentarius is used by several countries in the region. However food standards for traditional foods in the region are generally not included in the work of the Codex. The food control laboratories, especially those existing in the Arab countries of the Gulf, with their sophisticated equipment and highly qualified staff, can contribute to the preparation of national food composition tables. In some other countries of the Near East region, the laboratories need to be upgraded in terms of facilities, including equipment, training of personnel, sampling techniques and extra funds for the running costs. Certain food control laboratories charges fees for food analysis, such as in Jordan and Morocco. These laboratories with the extra funds they received for their services from the private sector were able to improve their system and employ higher qualified staff.

National Nutrition Institutes, which exist in some countries of the region such as Egypt, Iraq, Iran and Tunisia, can play a major role in the analysis of foods and the establishment of national food composition tables.

Food chemistry laboratories for the analysis of new varieties which have been selected by the agronomists, exist in most of the Agricultural Research Centers such as in Egypt, Tunisia and Morocco. These laboratories could take a part in a food composition programme.

In several countries of the region, the consumer has become aware of the relation of nutrition with disease. Consumers in certain countries such as Cyprus, Malta and the Arab Gulf are demanding foods that are low in fat, high in fiber, and low in cholesterol. Such foods have become locally processed or imported and they are increasingly available in the local market.

In most countries, the Faculties of Agriculture have a Department of Food Science and Nutrition, or Food Technology. These Departments not only offer undergraduate education but also graduate Masters and Ph.Ds degrees. The research programmes of graduate students included in most cases food analysis. Unfortunately many of the Masters and Ph.D. thesis are not published and the data are not disseminated.

With the economic reform (liberalization policy) such as in Egypt, Morocco, Tunisia and Jordan, several multinational companies started branches for their food industries. However, they are facing unfair competition from the local industry which does not comply with food regulations since national food standards do not exist or the food

control system is not efficient. The private sector in the field of food industry can play a role in the promotion of activities and in assuring fair competition and in avoiding poor manufacturing practices or false claims. Cooperation between the private sector, government agencies and non-government organizations (NGO) such as consumer protection association should be strengthened. Trade unions could be also involved in the national food composition programme.

Actions needed for the Development of Food Composition Activities in the Near East

Actions are required at the national, sub-regional and regional levels for updating and development of food composition activities in the Near East. The requirements and priorities for a country such as the UAE or Kuwait will be completely different from a country like Sudan or Mauritania. Each country will have to set up its own priorities depending on its needs. Consideration should be given in a particular country to whether it is a food importer or exporter, to membership of the GATT, and available resources. The policy commitment towards implementation of the ICN recommendations should be utilized to strengthen food composition and analysis activities.

Actions Needed

National level

A country which desires to develop its national food composition data should establish a coordinating committee with a focal point or a coordinator. The committee has to assess available resources, update their information on the status of their food composition, set up priorities and request financial and technical support as needed. They should formulate a plan of action, and agree on procedures such as sampling techniques, method of analysis and the collection and dissemination of the food composition data. They should avoid duplication and waste of resources. The members of the committee will vary according to the existing institutions which deal with food analysis in the country, but the involvement of the food control laboratories, academic and research institutions, private sector and NGO is essential.

Sub-Regional Network

In the Arab Gulf Countries which have a similarity in their dietary habit and undergoing fast and rapid socio-economic change, a sub-regional network for the establishment of food composition data is recommended. The national focal point in each country should be a member of the sub-regional network. The purposes of the sub-regional network are to exchange information, share experiences and expertise, set up priorities and avoid of duplication. A similar sub-regional network could be established for the North African countries (Tunisia, Libya, Algeria and Morocco). Another could be established for the Arab Countries of West Asia (Syria, Lebanon, Jordan, Iraq and Egypt). A similar sub-regional network could be established for Iran, Pakistan and Turkey.

Regional Net Work

Data from the different sub-regional networks could be collected and disseminated to the regional network on food composition which will be linked with the World Data Network to facilitate interchange of data and exchange of experiences.

The Role of FAO

FAO has a long historical experience and involvement in the development of regional food composition tables for the Near East. FAO assisted most of the countries of the Near East in the strengthening of their food analysis laboratories, mainly dealing with food control. The Secretariat of the Codex Alimentarius Commission, which is based in FAO, provides as international set of rules and guidelines intended to establish definition and requirement for food, harmonize food standards and in turn facilitate international trade and protect the health of the consumers. Furthermore, the Codex Alimentarius food standards are recognized by the General Agreement on Tariffs and Trade (GATT). This in turn will increase the necessity for food labeling and subsequently, food composition data.

FAO can assist the regional food composition network in the following areas :

1. Formulate and up-date standards and procedures that specify minimum quality criteria required for food composition data.

2. Assist in the selection of priority constituents of food to be analyzed, such as nutrient additives, natural toxins and contaminants in foods. These priorities should be associated with public health problems and trade in the region.

3. Assist in the introduction of quality assurance system that assures that the quality of the food composition data are accurate and valid.

4. Provide information and guidance on sampling procedures, selection of analytical methodologies and, above all, training manuals.

5. Play a major role in the dissemination and continuous revision of data on food composition that occur due to changes in product formulation, food processing techniques, food varieties, agriculture production systems and improvements in analytical technique.

SETTING PRIORITIES FOR FOOD COMPOSITION TABLES - THE UK EXPERIENCE

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Introduction

The preparation of comprehensive food composition tables can take a lot of time and money. First, there are many hundreds if not thousands of different foods in the shops and markets of most countries. These can vary in composition regionally, seasonally, by brand, by country of origin, and not only in familiar local dishes but also in a range of exotic recipes by immigrants from other cultures. So it could be thought necessary to include data on several thousand raw and cooked ingredients and dishes.

There are also well over 100 different nutrients, including a wide range of fatty acids, amino acids, and a number of sub-fractions of, for example the fat soluble vitamins, fibre, and other nutrients which are currently of special interest. Their extraction can require a range of pre-treatments, and their analysis may need a wide variety of different chemical, chromatographic, spectrophotometric and microbiological techniques (even for the basic vitamins), so that the full analysis of a single food sample can take weeks and cost more than $2000. So priorities have to be set.

First Priorities

On the assumption that there has been a commitment to found and do the work, it is useful to begin by setting up an expert steering group of users and compilers to help set priorities and to oversee and co-ordinate the programme.

This was perhaps less necessary for earlier food composition tables, which were done on a smaller scale and had a more limited purpose. For example, the first UK tables were compiled in 1914 for the military, and then between the 1920s and 1950s the medical researchers Robert McCance and Elsie Widdowson began by analyzing a range of common raw and cooked foods for carbohydrates and other macronutrients for their own work on diets for diabetics, and then for a number of minerals for their research on other aspects of diet and health. Nevertheless, the tables that they later produced were so useful to so many people that they became widely used both in Britain and elsewhere.

The UK Ministry of Agriculture, Fisheries and Food (MAFF) helped to produce the 4th (1978) edition of these tables (Paul and Southgate, 1978), and then in 1986 committed itself to a further full scale revision. This government Department has long been a major user of food composition tables for its dietary surveys and for helping to set and monitor its food and nutrition policies. They chose the Royal Society of Chemistry (RSC) as the contractor because of their experience of computerized databases, and one

(later two) people were employed to work full time on the tables. The steering committee that they set up should perhaps ideally have contained a large number of users including many different researchers, dietitians, nutritionists, analysts and consumers, as well as people from the food industry involved with the production, sale and preparation of food, but this would have made the group too unwieldy. So the actual group included selected users together with the compilers, but we then wrote to a very wide range of other people to seek their views.

One of the first tasks of such a group is to determine what information is needed for various purposes (e.g. Table 1), and the compilers must then compare this with what is available from local tables such those from as FAO (1982) and Musaiger & Aldallal (1987), and tables from other countries (if relevant), the scientific literature and the food industry. The aims are to make decisions on (i) whether the existing information might need to be updated because the foods have changed (for reasons such as those outlined in Table 2) or the methodology used for certain nutrients has become more specific or more reliable; (ii) what new foods and nutrients should be added; (iii) whether sufficiently reliable data on any of these foods might be available from other sources; (iv) whether all the missing data should be obtained, or whether some is of higher priority than the rest; (v) whether the new data that is needed is best obtained by new analyses, by interpolation or (mainly for cooked foods) by calculation; and then (vi) what the priorities are. These early decisions may, of course, need to be modified as the work progresses.

Table 1. What information is available and what is needed for :

* Research into diet & disease
* Evaluating dietary surveys
* Nutrition policies
* Setting dietary targets
* Planning individual and institutional diets
* Food labelling
* Education

Table 2. Some reasons for changes or additions to food composition tables

* Changes in unprocessed foods e.g. new fruit; new cultivars or breeds of fruit, vegetables and animals; different cuts of meat; changes resulting form new farming practices or country of origin
* New or re-formulated beverages, cereals products, confectionery, dairy products, desserts fats, infant foods, meat products, sauces, soups, etc.
* Mixed dishes, both local and for immigrant, and changed cooking methods
* New nutrients or nutrient fractions not previously inculded

Another early decision is whether the whole of the work should be completed before the tables are published, because this will affect the way the work is organized. Because of the scale of our task, and because it had taken the previous compilers almost 10 years to prepare the 4th edition of our tables, we decided instead to work through the food groups one at a time and to produce a series of books (and computer-readable versions) converting each group. There are nine such books in the UK now, covering immigrant foods; cereals and cereal products; milk products and eggs; vegetables, herbs and spices; vegetable dishes; fruit and nuts; fish and fish products; miscellaneous foods; and most recently, meat, poultry and game (Chan *et al.* 1995). A similar decision was taken in America when they updated the USDA Handbook no. 8, but we have also published an intermediate 5th edition (Holland *et al.* 1991) for the use of students and others who need a shorter handy reference book, plus a version of this for use in the nutrition labelling of food.

Sampling Schemes

Some food tables include only basic food ingredients, from which the nutrients in cooked dishes can be calculated (after measurement of weight changes and allowances for the expected losses of labile nutrients). But for the convenience of dietitians and other users, it is important if not essential to include a wide range of commercial and home-prepared food and mixed dishes, both raw and cooked in different ways. The range of foods and dishes in the UK is such that we have now included more than 300 foods in each food group, and our database currently contains more than 3000 foods in total (Table 3). This compares with 848 in the current FAO tables for the Near East (FAO, 1982)

Table 3. Growth in the number of common foods in UK

Food group	4th edition (1978)	New supplements (1989-1995)
Cereals & products	121	360
Dairy products & eggs	54	335
Vegetables, herbs & spices	125	462
Vegetable dishes	0	347
Fruit & nuts	147	340
Fish & products	97	308
Miscellaneous foods	ca. 200	418
Meats	142	429
Meat products & dishes	42	
Total (so far)	**ca. 930**	**3000**

All the foods that are to be analysed must be bought, and if necessary prepared and cooked. Decisions must be made on how many samples of each are needed, where they are to be obtained to ensure that they are representative, and whether all the samples of each food should be analysed separately or pooled. The range or standard deviation of each nutrient can be estimated if a sufficiently large number of samples is analysed, but because this is very expensive, and because users can rarely make use of information or variability, we decided instead to buy between 5 and 20 samples of each food from a range of outlets across the country (or, with manufactured foods, from a range of similar brands), and then after preparation or cooking (if needed) we pool them before analysis.

Since carefully designed sampling schemes take considerable effort, more use can be made of the samples and money can be saved (or at least shared between budgets) if there is interest in analysing other constituents in the same foods. These could include contaminants such as heavy metals, pesticides or radionuclides, or additives, or natural physiologically-active constituents such as flavonoids, purines, organic acids or lectins. This is important in the UK, where the nutrition programme must compete for resources with a number of other food quality and safety programmes.

Analysis

It is important to ensure that all the analyses are reliable, so quality control checks must be built in, reference samples must be included, and if possible all the laboratories should be accredited. It may also be necessary for different laboratories to analyse different nutrients in sub-samples of the same food if their expertise is very specific. All the early UK analyses were done by McCance and Widdowson themselves, but for many years now most have been done under contract in major goverment laboratories or in expert research laboratories. The food industry also does an increasing amount of food analysis, especially for food labelling purposes.

Nutrients

Given the number of foods that we analyse and the number of nutrients now of interest, we have found it not only impossible but also unnecessary to analyse every nutrient in each one. Indeed, our current programme does not include amino acids at all as our advice was that there is little new dietetic or research interest in them. It is also clearly unnecessary to analyse fibre or vitamin C in meat, fish or most dairy products, or fat-soluble vitamins in beverages, unless they have been added.

Further savings can then be made by restricting analysis of the full range of nutrients in a food group to the most important raw or cooked foods of that type, and by interpolating other values according to agreed criteria. For example, if the fat-soluble vitamins are measured in skimmed and whole cows milk then (after some checks) it may be possible to interpolate values for these nutrients in the less common cheeses, creams, yogurts and other dairy products on the basis of their fat content. It may also be

possible to estimate with sufficient accuracy for most purposes the amounts of the individual sugars or fatty acids in many foods from the total amount of sugars or fat together with the proportions of glucose, sucrose etc in the main ingredients.

So before we begin, we draw up detailed sampling and analysis frameworks showing exactly which nutrients are to be analysed in each food. A simplified representation of such a scheme is shown in Table 4. This is then coasted after it has been agreed, and it may then need to modified further by subtracting (or occasionally adding) selected foods or nutrients. The reason for all this is that it allows more foods to be included in the analytical programme than would otherwise be possible - and we are still able to include values for 12 minerals and 13 vitamins in the main tables, together with more sub-fractions of nutrients of particular importance to each food group which are shown in appendixes to the relevant books.

Although absolute accuracy for every nutrient in every food sample may seem to be the ideal, it should never be forgotten that most foods can be quite variable in composition and that estimates of individuals' food consumption can also be subject to considerable error. Furthermore, the number of foods and nutrient fractions continues to increase, and all these foods continue to change in composition, so that a rolling programme may be needed which includes the analysis of perhaps 400 foods per year (Table 5). We therefore believe that our mixture of selective analyses and calculation gives us the best and most cost-effective programme we can devise.

Table 4: Hypothetical analytical protocol

Food	Fat	FAs	Sugars	Fibre	Vit A	B_{12}	Vit C
Cereals	✓	✓	?	✓		?	
Dairy products	✓	✓	✓		✓	✓	✓
Fruit			✓	✓	✓		✓
Vegetables	?		✓	✓	✓		✓
Fats	✓	✓			?		
Meat	✓	✓			?	✓	
Lean & fat	✓	✓				✓	
Meat products	✓	✓		✓	?	✓	
Raw offals	?	?	?		✓	✓	✓
Fried offals	✓	✓			✓	✓	?

Table 5. Rolling programme of analysis proposed for the UK

Foods	Number of common foods	Number to be analysed every 5 years	Number to be analysed every 10 years
Cereals & products	350	250	100
Dairy & egg products	350	200	150
Fish & products	300	100	200
Meats & products	400	300	100
Fruits & Vegetables	800	150	650
Other foods	300	200	100
Total	2500	1200	1300

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VALIDATION OF ANALYTICAL METHODS FOR ESTABLISHING FOOD COMPOSITION DATA

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Introduction

Reliable data on the composition of foods can only be obtained by the careful performance of appropriate and validated analytical techniques in the hands of trained analysts.

Validation of an analytical method is the process by which it is established, by laboratory studies, that the performance characteristics of the method meet the requirements for the intended analytical applications. Typical performance characteristics include selectivity/specificity, working concentration range, sensitivity, limit of detection, limit of quantitation, ruggedness, accuracy, precision, and applicability.

The use of validated methods is one of the specific requirements for chemical laboratories aiming for accreditation to EN 45001 and ISO/IEC Guide 25 guidelines, or for certification to ISO 9000. They ensure fair trade of raw materials and foods by guaranteeing the results obtained when the products are analysed. For example depending on the water content of green coffee or the meat content of meat extract, price can be very different. Therefore we need accurate and precise methods to measure the moisture and the creatinine contents, respectively.

Reliable data are also required for authenticity, nutritional and safety assessments of foods, as well as for manufacturing process and quality control. For example detection of fraudulently added sucrose in orange juice (authenticity), evaluation of the nutrient pattern of a food and its impact on the daily intake (nutritional), determination of food contaminants or allergens (safety), homogeneity of vitamin addition in fortified formula (manufacturing process control), compliance to internal norms or legislation (quality control).

Before starting to apply an analytical procedure the analyst should have a clear view of the ability of the method to respond exclusively to the substance in question. In other words, he should be aware of the selectivity of the method which refers to the extent to which it can determine particular analyte(s) in a complex mixture without interference from the other components of the food matrix. Methods which are perfectly selective for an analyte or group of analytes are said to be specific. Others can be semi-specific or non-specific. For example : determination of glucose by the Boehringer enzymatic method (specific), of hexoses by the colorimetric enthrone method (semi-specific), and of reducing sugars by the Luff-Schoorl titrimetric method (non-specific).

Therefore, the influence of suspected interference should be carefully studied and documented. The selectivity of the method can also be assessed by applying it to reference materials (RM), either certified or not, and by comparing the results with the reference values. Alternatively, results of the method under evaluation can be compared with those obtained by another method based on a different principle. For example the microbiological determination of free niacine is subject to interference and yields higher results than the HPLC method.

In the final description of the method, tools for the assessment of the identity of the analyte should also be given.

Range of an Analytical Method

For quantitative analysis, the relationship of analyte response to concentration should be determined. This is usually achieved by examining standards or samples (typically more than 5 plus a blank) with analyte concentrations across the claimed range of the method. In most cases, the relationship is linear. For example the enzymatic determination of glucose follows a linear relationship.

The mathematical treatment of the data normally involves the calculation of a regression line by the method of least squares of the responses or tests results versus analyte concentrations. The slope of the regression line and its variance provide a measure of the linearity of the method; they intercept is a measure of the potential assay bias (systematic error). Plotting the test results graphically may be an acceptable alternative to calculation of the regression line. However, the relationship of analyte response to concentration does not have to be linear. Determinations of Ca by AAS or vitamin B12 by microbiology are good examples of methods with a non linear relationship.

The working range of an analytical method is the interval between the upper and the lower levels of analyte that can be determined with acceptable precision and accuracy using the method as written. It should be determined and validated by applying the method to samples containing the analyte at the extremes of the range as well as within the range.

Sensitivity

Sensitivity is the ability of the method to detect small variations in analyte concentration at a specified average value, or over the whole working range. In other words, it is the minimal difference in analyte concentration corresponding to a significant variation of the measured signal. It is represented by the slope of the analyte response to concentration curve. If the slope is steep, the method has high sensitivity; if the slope is shallow, the method has low sensitivity.

When a narrow range of concentration is of interest, a method with high sensitivity is desirable; for a wide concentration range, a method with low sensitivity is desirable. Sensitivity should not be confused with the limit of detection.

Limit of Detection

The limit of detection is defined as the lowest concentration of analyte in a sample that can be detected, but not necessarily quantified, under the stated experimental conditions. It allows the presence of an analyte to be confirmed. This is particularly important in the analysis of certain contaminants for which some national legislations set up maximum tolerable levels in foods precisely at the limit of their detection. For example the maximum level of pesticide residues in baby foods is 10 ppb (= limit of detection) in the German legislation.

It is also very useful in the assessment of authenticity of food products, such as in detection of common wheat in Durum wheat pasta, or cow's milk in ewe's cheese.

The limit of detection of an analytical method is therefore often used as a decision criterion. It is of less importance for the establishment of food composition table. The limit of detection is determined by repeat analysis of a blank sample and calculation the standard deviation of the response. It is expressed as the analyte concentration whose response is equivalent to the mean blank response plus 3 standard deviations. The value of the limit of detection is likely to vary for different types of samples. It should be subsequently validated by the analysis of samples known to be near or prepared at the limit of detection.

Limit of Quantitation

The limit of quantitation is the lowest concentration of analyte in a sample that can be determined with acceptable precision and accuracy under the stated experimental conditions. It is usually the lowest concentration point on the working range of the analytical method and, therefore, is always higher than the limit of detection. It can also be determined by repeat analysis of samples spiked with known (low) concentrations of analyte, and by establishing the minimum level at which it can be detected with accuracy (good recovery) and precision (good repeatability of the results). The limit of quantitation must not be determined by extrapolation, and should be subsequently validated by the analysis of samples known to be near or prepared at the limit of quantitation.

It is only be knowing the limit of quantitation that the analyst can rely on the results obtained on samples containing analyte concentrations in the very low range of the method, or he has to switch to a more sensitive method.

Ruggedness of the Method

Where different laboratories use the same method they inevitably introduce small variations in the procedure, which may or may not affect its performance. This is assessed by examining the ruggedness of the method which is its capacity to yield exact results in presence of small changes of experimental conditions such as might occur during its practical application.

A ruggedness test is an intralaboratory study in which the influence of small and deliberate changes in the operation and/or environmental conditions on measured responses is evaluated. The changes introduced (e.g. variation in temperature, time, reagent concentration) reflect the changes that can occur when a method is transferred between different laboratories, different technicians, different devices, etc. The test is normally performed by the laboratory establishing the method, before other laboratories apply it. The practical execution of a ruggedness test can follow different designs, more or less complex and time-consuming, supported by solid mathematical/statistical backup.

According to his practical experience, the method developer may limit the test to study the influence of only one or two critical parameters. The result of a collaborative study will tell him if the ruggedness of his method was sufficiently established, or whether he needs to go back to the bench.

Whatever the design of the test, the critical conditions which must be carefully checked and the proposed control procedures should be properly described in the method instruction.

Accuracy

Accuracy is the closeness of agreement between a test result and the accepted reference value (ISO 5725:1994). Other definitions refers to the "true" value instead of the accepted reference value. However, the "true" value is more a general concept and, in general, cannot be known exactly. Several tests can be performed to examine the accuracy of an analytical method. First of all, it can be assessed by analysing suitable reference materials (pure substance, certified reference material (CRM), in-house reference material) whose property value is well established, certified or accepted. Where suitable RMs are not available, accuracy can be estimated by applying the method to samples to which known amounts of analyte have been added, and by calculating the corresponding recovery. According to AOAC, recovery should be determined using at least 6 test samples, each at 3 concentrations for each matrix covering the range of concern. Ideally, the samples used in the recovery experiments should be free from the analyte before spiking, to avoid the extra analytical error that would be introduced by the determination of the initial analyte level. It should be recalled that the value of spiking is limited; it only determines the accuracy of those stages of the method following spiking. Furthermore, the added analyte is very rarely in the same chemical or physical environment as in a food matrix. For example : free sterols and sterols linked fatty acids, free pectin and pectin encapsulated in plant cell walls.

Therefore, the ease with which the analytes (added or endogenous) are extracted, their interaction with the food matrix, and the way they react to the method can be different. Consequently, poor recovery indicates that the method is not behaving properly, but good recovery does not necessarily guarantee satisfactory accuracy. Finally, the accuracy can also be established by comparison with results obtained by a reference method or other alternative procedures, and via collaborative studies.

Precision

The precision of an analytical method is the closeness of agreement between independent test results obtained under stipulated conditions. Precision is commonly measured either under repeatability or reproducibility conditions.

Repeatability conditions are conditions where independent test results are obtained with the same method on identical test items in the same laboratory by the same operator using the same equipment within short intervals of time (ISO 5725:1994).

Reproducibility conditions are conditions where test results are obtained with the same method on identical test items in different laboratories with different operators using different equipment (ISO 5725:1994).

Practically, to determine precision of the method under repeatability conditions, duplicate analysis of different samples, each at different concentrations covering the range of concern, are performed by the same analyst within the laboratory. The standard deviation of the results is calculated and the precision is expressed as repeatability standard deviation (S_r), also called within-laboratory standard deviation. It can also be expressed as repeatability relative standard deviation (RSD_r), which is the ratio of s_r to the mean value multiplied by 100, and as repeatability (r), which is equal to 2.8 times s_r. The repeatability value (r) is a very useful precision parameter as it represents the maximum tolerable difference between duplicate test results. If the difference is higher than the previously determined r value, the analysis should be repeated.

Alternatively, and depending on the aim of the method developer, "pseudo" repeatabilities can be determined within the same laboratory by the same or different analysts, using the same or different equipment, the same or different day. Each type of experiment will of course generate its own set of precision parameters (s_r, RSD_r, and r).

The Applicability of the Method

If the method is intended for use in different laboratories, the repeatability value found by the laboratory developing the method should be further validated by a collaborative study (or ring test). Ideally, the study should be conducted and results treated statistically as recommended by official guidelines (ISO, IUPAC, AOAC). Typically, the test requires the analysis of at least 5 materials by at least 8 laboratories, utilising either blind duplicates or a split level design (ISO 5725:1994). Data are tested for outliners on an assay-by-assay basis. Firstly, the data are tested by the Cochran extreme variance test that discards results from laboratories with poor within-laboratory variability (repeatability) compared to the variability of the other laboratories. Secondly, data are removed from laboratories that show extreme mean values (poor between laboratory variability) compared to the other laboratories by Grubbs tests. The repeatability of the method is then calculated from the remaining test results.

The collaborative study also allows the precision under reproducibility conditions to be

determined; in fact, it is the main reason to organise it. In that case, precision is expressed as reproducibility standard deviation (s_R), as reproducibility relative standard deviation (RSD_R), which is the ration of s_R to the mean value multiplied by 100, and as reproducibility (R), which is equal to 2.8 times s_R. The reproducibility value (R) is a very useful precision parameter as it represents the maximum tolerable difference between two test results from two different laboratories. It is particularly important to know the R value in case of conflict with a result (e.g. between a governmental and an industry laboratory). Details on the calculation of all precision parameters are given in the norm ISO 5725:1994.

It is not always possible to meet the official requirements for a collaborative study, which is usually a very time- and energy-consuming exercise. However, the study may be smaller, e.g. 4 laboratories or 3 samples, but at the sacrifice of confidence in the reliability of the estimated parameters.

Validation

The primary criterion of method selection is applicability. In other words, the operator should know before starting the analysis whether the method applies to the sample to test. Indeed, a method applicable to one type of matrix may be inapplicable to another. Therefore, the method should be fully validated with all the types of foods it is intended for, and the applicability clearly stated in the instruction. All laboratories should make it a rule to validate the method for the analysis of new types of foods, which have not been mentioned in the applicability domain of the method.

How far should an analytical method be validated ? Obviously, a collaborative study according to official guidelines cannot be organised for each method. The extent of validation depends on the use of the method and on the experience of the analyst developing it. A procedure intended to become an international standard (ISO, AOAC, IDF, IOCCC, etc) certainly needs a complete validation, including the determination of all precision parameters by a collaborative study. On the other hand, the determination of the reproducibility of a procedure that will be applied in only one laboratory (e.g. research purpose) is not indispensable. An analysis for a major nutrient (e.g. proteins in milk) can be performed without knowing the limits of detection and quantitation of the method. Furthermore, it is not necessary to analyse a large number of samples to establish its sensitivity. Finally, a ruggedness test can be limited by the setting up an appropriate quality assurance programme (e.g. very good control of the temperature) and a precise description of the method. Whatever the validation process used, all validation results should be fully documented.

Adopting a New Validated Method

Validated methods in the hands of poor analysts, or good analysts using unreliable equipment, will most likely yield unreliable data. Therefore, adopting a new validated method within the laboratory necessarily requires a short re-validation. Analysts should familiarise themselves with the method until the stated degree of accuracy and precision is achieved. In certain cases, own limits of detection and quantitation for the

laboratory should be established. A re-check of the analyte response to concentration relationship is almost unavoidable, specially for HPLC or GC techniques involving detectors from different manufacturers, each with a different sensitivity. Finally, it is wise to analyse reference materials if available, or to compare the results with those obtained on identical samples by an experienced laboratory, before starting the analysis of unknown test samples.

Quality Assurance

An analytical method should not perform well once only, just after the re-validation process. It should yield reliable data the whole year through, each time it is applied. To achieve this goal, a quality assurance (QA) programme should be set up within the laboratory. QA is defined as all those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality (ISO 9000).

The aim of QA at the laboratory is for the analyst to keep the analytical results at a specified degree of quality and to take the appropriate corrective actions to limit or suppress any sources of variation from the normal situation. In other words, the analytical process should be under control. This is achieved basically by education and training of the analysts, maintenance and calibration of instruments, testing of regent quality, and proper record-keeping system. Furthermore, the periodical analysis of control samples (reference materials) and monitoring the analysed values by plotting them on charts (control charting) will also help detecting any drift or deviation before the quality of the data is unacceptable (early warning).

A good QA programme should provide the confidence to the analyst that he is producing reliable results.

Quality Control

The QA programme has been set up and is run properly. However, there is no guarantee that the instruments are still correctly calibrated or that the reagents are still of acceptable quality at the time the analysis is performed. To provide an extra confidence, a quality control (QC) programme should be set up by the analyst. QC is defined as the operational techniques and activities that are used to fulfil requirements for quality (ISO 9000).

The level and type of QC will depend on criticality, nature of the analysis, frequency of analysis, batch size, degree of automation, and test difficulty and reliability. This is mainly achieved by analysis control samples and control charting. As a guide, 1 in every 20 samples (5%) analysed should be a QC sample for routine analysis with relatively simple procedures. For more complex methods 4 or even 10 QC samples in every 20 samples should be introduced.

Parallel analyses of samples spiked with known amounts of analytes may also be required to control the accuracy of the method when new batches of reagents or new

materials (e.g. immunoaffinity columns) are used. This procedure is frequently applied when no reference materials are available. Blank determination and replicate analysis of the test samples are also part of the QC programme. Alternatively, the laboratory manager can also introduce blind samples in a series of test samples, to make sure the QC is operated exactly under the same conditions as the actual analysis.

Finally, it is strongly recommended that the laboratory participates in proficiency tests. This enables it to monitor its performance against both its own requirements as well as those of the other laboratories. Participation in proficiency testing should be done on a regular basis. The tests highlight only repeatability and reproducibility performance between laboratories but also systematic errors.

As for the validation and the QA programme data, all results generated by the QC programme should be properly recorded. This will provide laboratory analysts and managers with objective measures of performance, and whether or not the laboratory is achieving its goals.

ESTABLISHING FOOD COMPOSITION TABLES FOR BAHRAIN

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Introduction

Bahrain like other Arab Gulf countries experienced a drastic change in socioeconomic status and food consumption patterns during the last three decades as a result of rise in income. The rapid decline in agriculture and increase in population have led the country to depend heavily on food importation. It was estimated that 95% of foods consumed are imported from various countries all over the world (Musaiger, 1995).

Justification for the Need of Food Composition Data in Bahrain

The need for data on the composition of foods commonly consumed in Bahrain has been raised by several authorities, particularly the Ministry of Health. Although there are some food composition tables available for use in the country, however none of them provide sufficient information on the foods consumed, especially those on composite dishes and traditional foods. The need of food composition tables can be justified in the following :

1. High prevalence of diet-related disease which need planning of special diet for therapeutic purposes, such as heart disease, diabetes, hypertension, cancer and kidney diseases.
2. Lack of information on composition of local foods (composite dishes, ready-made foods and traditional foods).
3. Estimation of nutrient intake from food consumption surveys as an aid to assessment of health and nutritional status of the people.
4. To be used as a tool for nutrition education, particularly in schools, colleges and other educational institutes.
5. Studying the relationship between diet and diseases.
6. Designing and implementation of food legislation and labeling.

Steps in Establishing the Food Composition Tables

Obtaining food composition data from literature review

Since Bahrain is highly dependent on imported foods, data for imported raw and processed foods were derived from values reported in the country of origin. Bahrain has good and reliable statistic from the country of origin of each imported food item, which are published annually by the Central Statistics Organization (CSO, 1983). The main countries which export foods to Bahrain were recorded based on type of foods exported.

The nutrient data on foods were extracted from tables of food composition in these countries. However, only countries which have well-established food composition tables were included in this project.

Obtaining data on composition of food through chemical analysis

Chemical analysis for 43 local dishes and 7 ready-made foods available in the market of Bahrain were done. Due to shortage of facilities and trained personnel, the chemical analysis was carried out in the Institute of Nutrition, Bangkok, Thailand. Only proximate analysis was done [Protein, fat crude fiber, ash, carbohydrates (by difference) and energy]. The ingredients were purchased from two sources; First, the market of Bangkok and this included most ingredients with same origin or brand names as in Bahrain. Second, from the market of Bahrain, and this included ingredients which were unavailable in Bangkok. All ready-made foods were purchased from Bahrain. Recipes of dishes were obtained from several local recipe books. The selection of dishes based on their popularity and their consumption in social and religious occasions such as Ramadan (the fasting month for Muslim), wedding, feasts and during puerperium. An experienced Bahraini housewife was selected to prepare the dishes. Dishes were prepared at least once to adjust the recipe to its most commonly consumed version. The dishes were them standardized and all ingredients were weighed carefully using a scale of a minimum capacity of 1 gram. The weight of dishes before and after cooking were obtained to determine amount of water lost during cooking.

Obtaining food composition data from recipe calculation

Five dishes were chemically analysed for calcium and iron in addition to proximate composition. An attempt was first made to calculate the nutrients using a combination of food composition tables available in the region. In general, the values for protein, fat energy, calcium and iron were lower than the values by calculation. Vitamins were excluded from the calculation because of absent vitamin values in some food composition tables.

The U.K. recipe programme (Food Research Institute, 1985) was then used for calculation of nutrients for the same five dishes. It was found that the calculations using this programme are in good agreement with the chemical analysis. Therefore it was decided to use the UK recipe programme for calculation of minerals and vitamins for the 43 composite dishes. The loss of water and effect of cooking on some vitamins were taken into consideration when calculating the nutrients of the dishes.

It is worth noting that the UK Recipe programme is based on foods available in UK. This may affect the validity of the calculated values for nutrients a little, but will provide a useful guide to the average dishes commonly consumed in Bahrain.

Presentation the food composition data

The food composition data were presented in five tables. The names of the foods and dishes are provided in English and Arabic. The tables were presented as follows (Musaiger and Al-Dallal, 1985) :

Table 1. Composition of edible portion of foods (based on literature review)

This table includes information on proximate analysis, three minerals (Ca. P. Fe) and five vitamins (vitamins A, B, B2, Niacin and C). The source of data for each food item was mentioned (see example table 1).

Table 2. Proximate composition of ready-made foods

This table includes proximate composition of seven ready-made foods chemically analysed (see Table 2).

Table 3. Composition of composite dishes

For the sake of comparison data on composite dishes in this table were same as those included in Table 1 (see example Table 3).

Table 4. Mineral composition of composite dishes.

Seven minerals were included in this table, potassium, magnesium sulphur, chloride, zinc, copper and sodium (see example in Table 4)

Table 5. Vitamin composition of composite dishes

Seven vitamins were included in this table namely vitamins D, E, B6, B12, folic acid, biotin and pantonthenic acid (see example in Table 5).

Methods of preparation of dishes

Type and weight of ingredients (in grams) and method of preparation of each dish were provided with these Tables to give a general picture about these dishes for the users (see Table 6).

Appendices

Three appendices were included in the final publication. These are : chemical composition of tap water according to geographical areas in Bahrain, cholesterol content of foods (based on literature review), and common Arabic and Scientific names of most food items included in Table 1.

Obstacles

Various obstacles were faced during preparation of these food composition tables. These can be summarized as follows :

1. Lack of trained personnel in chemical analysis of foods.
2. Lack of experience of the personnel in preparation of the food samples for analysis.

3. Absence of standardized recipes, which necessitated preparing the recipe several times to be adjusted for the commonly consumed version.
4. Difficulties in weighing some ingredients, such as garlics and spices, because their weight in some recipes were less than one gram. To overcome this problem we weighed larger amounts of these foods and took the average weight of a piece of garlic or the average of a teaspoon of spices.
5. Absence of information on some local ingredients in the UK Recipe Programme. This emphasis the need for establishing a local recipe programme.
6. Since some foods in UK are fortified, the calculation using UK Recipe Programme for Bahraini dishes may give misleading information on nutrients. This is particularly true for dishes contained flour (which is usually fortified in UK).

Conclusions

1. The food composition tables prepared in this project provide more relevant data to Bahrain, and maybe to other Arab Gulf states
2. The use of computer programmes to calculate the nutrients in recipes can reduce the cost of chemical analysis and at the same time produce appropriate data on composition of the recipes.
3. For a country like Bahrain, where most foods consumed are imported, composition of foods may be obtained from countries of origin that have good food composition data.
4. The current food composition tables should be revised and updated to include more food items, dishes and traditional foods.

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Musaiger, A. O. (1995). Current situation of food-borne diseases in Bahrain. *Dairy, Food and Environment*, 15, 1, 21-27.

TABLE 1. COMPOSITION OF FOODS PER 100 GRAMS EDIBLE PORTION

جدول (١) : محتويات الأغذية من العناصر الغذائية (لكل ١٠٠ جرام من الجزء الصالح للأكـــل)

No. رقم التسلسل	Food الغـــذاء	Arabic Name الاسم العربي	Water g ماء (جم)	Protein g بروتين (جم)	Fat g دهون (جم)	Ash g معادن (جم)	Fibre g الياف (جم)	Carbo-hydrate g مواد نشوية (جم)	Energy Kcal طاقة حرارية (سعرة)	Minerals العناصر المعدنية			Vitamins الفيتامينات					Refer-ence المصدر
										Calcium mg كالسيوم (ملجم)	Phosphorus mg فوسفور (ملجم)	Iron mg حديد (ملجم)	Retinol µg فيتامين ا (ميكروجم)	Thiamin mg ثيامين (ملجم)	Riboflavin mg ريبوفلافين (ملجم)	Niacin mg نياسين (ملجم)	Vitamin C mg فيتامين ج (ملجم)	
1.	CEREAL AND CEREAL PRODUCTS الحبوب ومنتجاتها																	
1.1	Barley	شعير	12.5	11.5	1.3	1.2	3.9	69.6	336	26	215	3.0	0.83	0.47	0.2	5.4	0	1
1.2	Corn	ذره	14.9	11.1	3.6	1.5	2.7	66.2	342	10	348	2.0	7.5	0.42	0.1	1.8	0	1
1.3	Corn, starch	نشا الذره	12.1	0.2	0.8	0.1	0.1	86.8	368	-	-	-	-	-	-	-	-	2
1.4	Macaroni, raw	مكرونه	10.4	13.7	2.0	-	-	79.2	370	26	150	1.4	0	0.14	0.06	2.0	0	3
1.5	Rice, raw	رز	13.3	7.5	1.0	0.9	0.6	76.7	346	10	190	3.2	0.17	0.21	0.16	3.9	0	1
1.6	Rice, flour	طحين الرز	8.0	6.9	1.1	0.5	0.5	83.5	377	10	102	2.4	-	-	-	-	-	2
1.7	Rice, (Peshawar)	رز بشاور	11.2	7.8	2.3	0.5	-	78.1	364	16	153	2.8	-	-	-	-	-	4
1.8	Rice, polished boiled	رز مصفى ومسلوق	71.3	3.8	0.2	0.2	0	24.4	118	4	66	0.6	-	0.02	0.01	0.5	-	2
1.9	Sago palm starch	طحين الساكو	8.2	2.4	0.2	0.3	-	88.9	367	10	21	-	-	-	-	-	-	2
1.10	Vermicelli	بلاليط	9.2	14.2	1.1	0.8	-	74.7	367	26	198	1.4	-	-	-	-	-	4
1.11	Wheat, perboiled	برغل (جريش)	13.0	12.5	1.5	1.7	1.5	69.8	350	40	450	3.5	0	0.4	0.04	4.3	-	5
1.12	Wheat, whole	قمح	13.0	11.5	2.2	1.7	2.3	69.3	354	36	383	3.1	0	0.57	0.12	4.3	-	5

TABLE 2. COMPOSITION OF COMPOSITE DISHES COMMONLY CONSUMED IN BAHRAIN PER 100 GRAMS EDIBLE PORTION

جدول (٢) : العناصر الغذائية التى تحتويها الأكلات الشعبية الشائعة فى البحرين (لكل ١٠٠ جرام من الغذاء)

No. رقم التسلسل	Food الغذاء	Arabic Name الاسم العربي	Water g ماء (جم)	Protein g بروتين (جم)	Fat g دهون (جم)	Ash g معادن (جم)	Fibre g الياف (جم)	Carbo-hydrate g مواد نشوية (جم)	Energy Kcal طاقة حرارية (سعره)	Minerals العناصر المعدنية			Vitamins الفيتامينات					Refer-ence المصدر
										Calcium mg كالسيوم (ملجم)	Phosphorus mg فوسفور (ملجم)	Iron mg حديد (ملجم)	Retinol µg فيتامين أ (ميكروجم)	Thiamin mg ثيامين (ملجم)	Riboflavin mg ريبوفلافين (ملجم)	Niacin mg نياسين (ملجم)	Vitamin C mg فيتامين ج (ملجم)	
1	Aaloo	آلو	57.8	2.1	19.7	1.7	2.2	16.5	252	61.3	59.1	0.8	0	0.155	0.067	1.7	20.9	11,12
2	Aaloo Chab	آلو حاب	56.7	6.6	13.3	1.5	2.6	19.3	223	53.3	82.1	1.3	16.5	0.112	0.128	1.5	11.4	11,12
3	Aaseedah	عصيده	51.8	4.3	11.9	0.4	2.0	29.6	243	29.2	109.9	1.3	93.9	0.111	0.098	1.2	0.6	11,12
4	Aigalee	عقيلي	22.1	10.1	9.4	1.1	0.6	56.7	352	41.4	214.3	2.4	84.6	0.204	0.253	2.1	0	11,12
5	Bajelah	باجله	75.0	6.2	1.0	0.7	0.8	16.3	99	65.9	21.8	0.7	0	0.07	0.029	0.9	0	10,11
6	Balaaleet	بلاليط	57.1	5.5	6.1	0.3	0.6	30.4	199	51.0	57.7	1.2	47.9	0.116	0.158	1.7	0.9	10,11
7	Betheeth	بتيث	17.6	2.6	6.4	1.0	1.4	71.0	392	132.0	87.4	5.2	109.0	0.408	0.112	6.5	0	11,12
8	Biriyani Laham	بريانى لحم	58.2	8.1	6.4	1.2	0.7	25.4	192	52.1	79.9	0.9	8.8	0.061	0.076	1.8	3.8	10,11
9	Chebah Rebian	جبه ربيان	74.1	5.2	2.5	1.3	0.6	16.3	109	159.6	52.5	2.1	0	0.096	0.055	1.2	14.9	11,12
10	Custard	كاستر	80.7	3.8	3.1	0.7	0.08	12.61	90	127.7	77.3	0.1	37.0	0.042	0.201	0.1	1.6	11,12
11	Dahal	دال	77.6	4.5	2.5	1.3	0.9	13.2	93	41.5	56.3	1.9	0	0.125	0.062	0.7	9.6	10,11
12	Elbah	إلبه	73.9	4.3	3.3	0.5	0.2	17.8	118	96.1	128.9	0.7	65.4	0.054	0.267	0.1	1.0	11,12
13	Faaloodah	فالوذة	79.0	0.9	0.9	0.6	0.2	18.4	85	125.4	29.0	0.8	10.7	0.013	0.081	0	0.5	11,12
14	Gellab	جلاب	43.8	0.1	0.0	0.3	0.0	24.0	333	22.3	76.3	0.8	332.4	0.089	0.016	1.1	0	11,12
15	Hamburgers	همبرجر	53.5	19.3	17.1	2.2	1.8	6.1	256	45.6	236.3	3.9	23.8	0.126	0.421	4.7	3.0	11,12

TABLE 3. COMPOSITION OF READY-MADE FOODS COMMONLY CONSUMED IN BAHRAIN PER 100 GRAMS EDIBLE PORTION

جدول (٣) : المناصر الغذائية التى تحتويها بعض الأغذية الجاهزة الشائعة فى البحرين (لكل ١٠٠ جرام من الغذاء)

No. رقم التسلسل	Food الغذاء	Arabic Name الاسم العربي	Water g ماء (جم)	Protein g بروتين (جم)	Fat g دهون (جم)	Ash g معادن (جم)	Fibre g الياف (جم)	Carbo-hydrate g مواد نشوية (جم)	Energy Kcal طاقة حرارية (سعره)	Minerals العناصر المعدنية			Vitamins الفيتامينات					Refer-ence المصدر
										Calcium mg كالسيوم (ملجم)	Phosphorus mg فوسفور (ملجم)	Iron mg حديد (ملجم)	Retinol µg فيتامين ا (ميكروجم)	Thiamin mg ثيامين (ملجم)	Riboflavin mg ريبوفلافين (ملجم)	Niacin mg نياسين (ملجم)	Vitamin C mg فيتامين ج (ملجم)	
1	Hallwah	حلوه	15.3	1.0	11.4	0.2	0.6	71.5	393	-	-	-	-	-	-	-	-	12
2	Khubez	خبز كريشي	25.2	7.0	0.8	2.2	0.4	64.4	293	-	-	-	-	-	-	-	-	12
3	Mattaai	متّاي	3.4	19.3	28.3	0.9	4.4	39.7	491	-	-	-	-	-	-	-	-	12
4	Mehiawah	مهياوه	67.6	8.0	2.6	5.5	1.8	14.5	113	-	-	-	-	-	-	-	-	12
5	Nashaab	نشّاب كويتي	4.2	8.5	9.6	1.0	1.1	75.7	423	-	-	-	-	-	-	-	-	12
6	Rahash	رهش كريشي	0.4	16.4	29.1	2.0	2.0	50.1	528	-	-	-	-	-	-	-	-	12
7	Sambosa Hellwah	سمبوسة حلوة	10.5	5.4	12.0	0.6	0.7	70.8	413	-	-	-	-	-	-	-	-	12

TABLE 4. MINERALS COMPOSITION OF COMPOSITE DISHES COMMONLY CONSUMED IN BAHRAIN PER 100 GRAMS EDIBLE PORTION

جدول (٤) : العناصر المعدنية التى تحتويها الأكلات الشعبية الشائعة فى البحرين (لكل ١٠٠ جرام من الغـــــــذاء)

(mg/100g) (ملجم / ١٠٠ جرام)

No. رقم التسلسل	Composite Dishes اســـم الأكلـــه	Arabic Name الاسم العربى	Potassium بوتاســـيم	Magnesium مغنســـيم	Sulphur كبريـــت	Chloride كلوريـــد	Zinc زنـك	Copper نحاس	Sodium صوديم
1	Aaloo	آلو	791.8	36.4	57.182	592.7	0.438	0.215	328.8
2	Aaloo Chab	آلوحباب	494.1	25.7	77.439	560.6	0.958	0.157	338.9
3	Aaseedah	عصيده	110.7	32.3	34.047	260.4	0.905	0.110	170.3
4	Aiqalee	عقيلي	195.8	58.0	86.327	120.1	1.906	0.184	89.2
5	Bajelah	باجله	174.2	0.8	0.059	158.3	0	0	133.8
6	Balaaleet	بلاليط	146.0	21.0	49.377	192.4	0.893	0.118	195.4
7	Betheeth	بثيث	1303.0	180.4	74.661	1083.8	2.641	0.572	437.1
8	Biriyani Laham	بريانى لحم	220.6	18.7	77.748	1112.8	1.412	0.086	715.4
9	Chebah Rebian	جبة ربيان	244.4	44.5	12.992	356.3	0.765	0.136	323.3
10	Custard	كاستر	161.7	13.0	31.743	124.3	0.37	0.029	68.8
11	Dahal	دال	285.7	25.8	33.832	546.9	0.673	0.154	343.0
12	Elbah	إلبه	149.4	12.2	74.212	110.7	0.706	0.047	75.7
13	Faaloodah	فالوده	57.1	3.7	9.157	30.8	0.107	0.009	28.0
14	Gellab	جلاب	77.5	27.9	3.988	602.6	0.646	0.093	386.9
15	Hamburgers	هامبرجر	401.1	37.4	234.335	1178.1	4.979	0.227	800.9
16	Hareese	هريس	127.5	35.7	27.483	604.3	1.260	0.107	390.0
17	Hesso	حسو	292.5	24.9	22.706	23.4	0.696	0.013	80.3

TABLE 5. VITAMINS COMPOSITION OF COMPOSITE DISHES COMMONLY CONSUMED IN BAHRAIN PER 100 GRAMS EDIBLE PORTION

جـدول (٥) : الفيتامينات التى تحتويها الأكلات الشعبية الشائعة فى البحرين (لكل ١٠٠ جرام من الغـــــــــذاء)

No.	Composite Dishes	Arabic Name	Vit.D µg	Tryptophan/60 mg	Vit.E mg	Vit.B_6 mg	Vit.B_{12} µg	Folic Acid µg	Biotin µg	Panto. Acid mg
رقم التسلسل	اســـم الأكلـــه	الاسـم العربـــى	فيتامين د ميكروجرام	تريبتوفان/ ٦٠ ملجـــم	فيتامين هـ ملجـم	فيتامين ب٦ ملجـم	فيتامين ب١٢ ميكروجـم	حمض الفوليك ميكروجرام	بايوتين ميكروجـم	حمض البانتوثينك ملجـــم
16	Hareese	هريس	0	1.2	0.3	0.2	0.3	19.6	1.502	0.272
17	Hesso	حسو	0.2	0.5	0.2	0	0.2	6.4	3.154	0.227
18	Jereesh Rebian	جريش ربيان	0	0.5	0.4	0.1	0.3	29.9	1.762	0.234
19	Kabab	كباب	1.0	2.2	0.9	0.1	1.0	204.6	14.794	1.098
20	Keema	قيمه	0	18.1	6.6	2.2	7.7	307.1	9.339	5.041
21	Khabeesah	خبيصه	0.4	3.3	1.0	0.3	0	69.4	1.473	0.48
22	Khanfaroosh	خنفروش	1.8	6.5	1.6	0.3	1.7	108.2	26.532	2.203
23	Loobah	لوبه	0	0	0	0	0	77.1	0	0
24	Madroubah Rebian	مضروبة ربيان	0	0.3	0.2	0.1	0.3	18.6	0.792	0.158
25	Macarona	معكرونه	0	1.6	0.4	0.1	0.5	25.7	0.875	0.326
26	Machbous Dajaj	مجبوس دجاج	0	1.2	0.3	0.2	0	28.3	1.703	0.453
27	Mahamer	محمر	0	0.5	0.1	0.1	0	16.1	1.092	0.218
28	Mahlabiyyah	محلبيه	0	0.9	0.1	0	0.3	10.1	2.252	0.394
29	Markoukah Dajaj	مرقوقة دجاج	0	1.2	0.7	0.2	0	38.8	2.429	0.437
30	Masley Laham	مصلى لحم	0	1.8	0.1	0.2	0.6	35.6	0.866	0.399
31	Momowash Rebian	مموش ربيان	0	0.6	0.3	0.1	0.2	33.6	0.987	0.197

RECIPES

Aaloo

330 g	potatoes	3 g	garlic, minced
54 g	onion, minced	63 g	oil
0.5 g	chilli powder	889 g	water
2 g	salt		

Brown onion and garlic with oil. Add little water, chilli and salt; cook until well done. Boil potatoes until soft; drain and mash them; add salt and mix well. Shape portion of potatoes into balls. Make a hole into each ball and fill with mixture. Close opening and shape into round thick cakes. Fry in hot oil until brown. Serve hot.

Aaloo Chab

320 g	potatoes	20 g	breadcrumbs
37 g	onion, minced	90 g	oil
50 g	beef, minced	2.5 g	salt
2 g	garlic, minced	1.5 g	mixed spices
51 g	1 egg	898 g	water

Brown onion and garlic with oil. Add beef, water, spices and salt, cook until meat brown. Boil potatoes until soft, drain and mash them, add salt and mix well. Shape portion of potatoes into balls. Make a hole into each ball and fill with mixture. Close opening and shape into round thick cakes. Dip in beaten egg, then in breadcrumbs. Fry in hot oil until brown. Serve hot.

Aaseedah

107 g	sugar		
125 g	wheat flour, browned		
58 g	butter		
1 g	cardamom, ground		
1.5 g	ginger, ground		
362 g	water		

Topping:

37 g	onion, minced		
102 g	2 eggs		
0.5 g	salt		
1 g	mixed spices		
8 g	oil		

Brown sugar, add water and cook until all the sugar is dissolved, bring to boil. Knead flour with water until tender paste. Mix with sugar. Add the rest of ingredients and cook until it becomes a thick mixture. For topping, beat all the ingredients. Fry in oil until brown. Place on top of the mixture.

COMPOSITION OF SOME TRADITIONAL FOODS AND DISHES IN THE ARAB COUNTRIES OF THE GULF

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Introduction

Traditional foods are nutritionally important in the diets of communities. Being well placed in norms and habits in the Gulf, these traditional foods could be attached to certain ethnic societies or groups. Moreover, the availability of raw materials, of plant and animal origin, dictate some biological constraints that define and restrict these foods to certain biological niches.

According to Messer and Kuhnlein (1986), the anthropological implications in traditional foods are important besides the ecological, cultural and nutritional aspects. Given the limited resources of the Gulf, indigenous food practices are so much influenced by the historical influxes from some neighboring countries. These traditions developed through time, with much interwinding with the cultural setup in the region, and helped to overcome the seasonality of limited produce, such as that of fish, milk and vegetables.

Traditional foods and dishes in the Gulf included in this work are related to raw materials upon which processing is based. Therefore, groups include cereal-based products, vegetables and fruit products, meat, fish, chicken products and dairy products, in addition to other miscellaneous items. This work focuses on the composition of some traditional foods and dishes commonly consumed in the Arabian Gulf, with respect to proximate analysis, and some minerals.

Materials and Methods

Source of Foods and Dishes

Traditional foods and dishes were procured from market retailers in each of the countries in the Gulf namely Bahrain, Oman and UAE. Some dishes were obtained from households in Dubai, UAE.

Methods of Analysis

A single sample of each food or dish of 150-200g were homogenized in a laboratory blender for 2-3 minutes, and then transferred to air-tight containers, and stored refrigerated below 7°C prior to analysis. Duplicates of each sample were averaged for each parameter. Compositional analysis, mineral and salt content, were performed.

Compositional Analysis

This included determination of moisture, ash, fat, protein, crude fiber and carbohydrates. Moisture was determined by drying a known quantity of 2-3g at 102±3C in an air oven. In some cases, the sample was mixed with acid-washed ignited sand to facilitate removal of water (AOAC, 1991).

The ash content was determined by charring a sample (about 5g) on a hot plate and ashing the sample in a muffle furnace at 450±20C. Hydrogen peroxide was used to ease the ashing process (AOAC, 1991).

Fat content was determined by the Rose-Gottlieb method in sugary samples, and the Werner-Schmidt method for samples containing meat (Egan, 1982).

The protein content was determined by the Kjeldhal method using the Buchi protein analyser. The N-content was multiplied by a factor of 6.25 to deduce the crude protein value.

The crude fibre was determined as described in A.O.A.C. method (AOAC, 1991).

Carbohydrate content was obtained by differencing. The calorific value of the sample was determined by summing-up fat x9.0 and protein x4.0 and carbohydrates x 4.0.

Salt Determination

The ash obtained from the previous samples was dissolved in 4x25ml of boiling distilled water, and filtered in a conical flask. The filtrate was cooled to room temperature and titrated with 0.1N AgNo3, using potassium chromate as an indicator, and self content was calculated as percentage of NaCl (AOAC, 1991).

Determination of minerals and heavy metals

The previous ash sample was dissolved in 5ml of conc. HCL, made up to 50ml in a volumetric flask. The minerals Na, K,Ca, Mg, Fe, Cu, Zn, were analysed by flame atomic absorption. Spectrophotometer (Varian AA 20) equipped with flame and graphite thermal analyser. Heavy metals (Pb,Cd) were analysed by graphite furnace atomic absorption Unit. Phosphorous was analysed as phosphate using ion chromatograph (Dionex 100), equipped with conductivity detector. Appropriate dilutions of ash solutions were made to bring mineral concentration within the range of caliberation graph of the atomic absorption unit, and results were expressed as ppm. (AOAC, 1991).

Results and Discussion

In view of the complexity of traditional foods and dishes, some selected examples were chosen to illustrate these classes of diet. In fact, this complexity goes back to the recipe and ingredients, together with the varying methods of preparation across the Gulf countries.

Harees : This is parboiled, soaked wheat grains, mixed, and heavily mashed in meat, spices and salt (Musaiger and Aldabbal 1985). The product is very difficult to standardize, as reflected in compositional and mineral analysis in table 1. However, this is a carbohydrate-rich food, of relatively high Na content.

Machboos : This is a mixture of rice and meat/chicken together with onion, tomatoes, garlic and miscellaneous spices. This another dish that is rich in carbohydrates (Table 2).

Mixed Rice : This is a popular dish in the Gulf, and probably of an Asian influence, as rice is the staple there. It is another carbohydrate rich dish, with a relatively high calcium and magnesium content (Table 3).

Asseda : A dessert-type of dish commonly taken during social sittings. It is relatively high in fat, calcium and iron (Table 4).

Sweet Sambosa : A type of pastry product of thin sheets of dough, stuffed with various nuts, and honey; being characteristic to Bahrain (Musaiger, 1993). It is rich in carbohydrate, fat and potassium (Table 5).

Chamy : This is a cottage cheese-like product. Naturally acidified milk is cooked and strained through cheese cloth to yield product that could easily be mixed in other dishes, such as salad. As a dairy product, it is rich in protein, calcium and sodium (Table 6).

Yaget : Results show a comparison between an Omani and a Bahraini Yaget; dried yoghurt balls. The product is rich in protein, calcium and sodium. Moisture content showed slight variation between the two samples (Tables 7).

Oama : This is a dried salted Indian sardine, commonly used as an additive, whole in stew, or powdered, when added to various dishes. The product is relatively high in ash, salt and sodium content, that probably gives a salty taste that consequently limits its use to small quantities (Table 8).

Conclusions

It is clear that variation in recipes could result in apparent differences between the assessed parameters due to lack of standardization in preparation, cooking and processing. The location and site of sampling could add to the complexity, and calls for homogeneity in sampling. Moreover, the information on these products obtained from old ladies who usually mix myths with facts. Widening the range of surveys could make up for variation in information on samples.

While carrying out these analyses, it was somewhat difficult to follow vitamin assessement. Moreover, following the route of contamination with minerals and heavy metals in some foods/dishes could throw lights on their safety. Microbial contamination, especially for fermented and sun-dried products, could also be another area to investigate. To this end, identifying a suitable native staff for data collection in the right venue to pursue the subject of traditional foods and dishes in a meaningful approach.

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Table 1. PROXIMATE AND MINERAL COMPOSITION OF HAREES

Parameter		Sample1	Samples 2
Proximate composition			
Moisture %	w/w	79.9	82.7
Fat %	w/w	2.6	2.0
Protein %	w/w	4.1	5.5
Carbohydrates %	w/w	12.2	9.0
Ash %	w/w	0.9	0.5
Crude fibre %	w/w	0.3	0.2
Salt %	w/w	0.60	0.5
Calorific Value kcal/100g		89	77
Mineral composition (ppm)			
Na		2628	1662
Ca		818	1171
K		53	92
Mg		158	142
Cu		0.58	0.86
Pb		<0.02	<0.02
Zn		9.05	11.2
Fe		7.30	17.0

Table 2. PROXIMATE AND MINERAL COMPOSITION OF MACHBOOS

Parameter			Sample I	Sample II
Proximate Composition				
Moisture	%	w/w	68.0	72.1
Fat	%	w/w	5.3	1.6
Protein	%	w/w	5.5	3.7
Carbohydrates	%	w/w	20.5	21.0
Ash	%	w/w	0.4	1.1
Crude fibre	%	w/w	0.3	0.2
Salt	%	w/w	0.9	0.8
Calorific Value kcal/100g			152	114
Mineral composition (ppm)				
Na			2948	1127
Ca			1814	629
K			90	91
Mg			139	207
Cu			1.0	0.64
Pb			<0.02	<0.02
Zn			5.95	7.43
Fe			9.98	13.4

Table 3. PROXIMATE AND MINERAL COMPOSITION OF MIXED RICE

Parameter		Sample I
Proximate Composition		
Moisture %	w/w	64.8
Fat %	w/w	7.0
Protein %	w/w	8.1
Carbohydrates %	w/w	18.9
Ash %	w/w	1.1
Crude fibre %	w/w	0.1
Salt %	w/w	0.6
Calorific Value kcal/100g		171
Mineral composition (ppm)		
Na		397
Ca		1091
K		62
Mg		208
Cu		1.00
Pb		<0.02
Zn		8.2
Fe		11.8

Table 4. PROXIMATE AND MINERAL COMPOSITION OF ASEEDA

Parameter		Sample I
Proximate Composition		
Moisture %	w/w	66.7
Fat %	w/w	4.9
Protein %	w/w	1.1
Carbohydrates %	w/w	27.9
Ash %	w/w	0.2
Crude fibre %	w/w	0.2
Salt %	w/w	0.1
Calorific value kcal/100g		160
Mineral composition (ppm)		
Na		632
Ca		1083
K		221
Mg		190
Cu		1.17
Pb		<0.02
Zn		9.3
Fe		63.7

Table 6. PROXIMATE AND MINERAL COMPOSITION OF CHAMY

Parameter		Chamy
Proximate Composition		
Moisture %	w/w	80.3
Fat %	w/w	4.8
Protein %	w/w	12.5
Carbohydrates %	w/w	1.3
Ash %	w/w	1.1
Crude fibre %	w/w	Traces
Salt %	w/w	0.5
Calorific value kcal/100g		98
Mineral composition (ppm)		
Na		2866
Ca		3631
K		128
Mg		296
Cu		2.10
Pb		<0.02
Zn		13.2
Fe		60.4

Table 7. PROXIMATE AND MINERAL COMPOSITION OF YAGET

Parameter		Sample I	Sample II
Proximate Composition			
Moisture %	w/w	5.2	7.69
Fat %	w/w	5.33	34.5
Protein %	w/w	36.2	34.7
Carbohydrates %	w/w	4.03	3.95
Ash %	w/w	9.03	14.4
Crude fibre %	w/w	0.44	Traces
Salt %	w/w	7.17	11.4
Calorific Value kcal/100g		532.8	330
Mineral composition (ppm)			
Na		1812	1146
Ca		1231	1258
K		1298	3793
Mg		453	560
Cu		0.47	7.82
Pb		<0.02	0.12
Zn		6.82	16.2
Fe		23.5	452
P		2820	1983
Cd		<0.01	0.04

Table 8. PROXIMATE AND MINERAL COMPOSITION OF OAMA

Parameter		Sample I	Sample II
Proximate Composition			
Moisture %	w/w	11.9	11.94
Fat %	w/w	2.68	3.16
Protein %	w/w	64.0	66.8
Carbohydrates %	w/w	Trace	Trace
Ash %	w/w	20.7	17.3
Crude fibre %	w/w	0.8	0.76
Salt %	w/w	3.8	1.25
Calorific Value kcal/100g		280.1	295.1
Mineral composition (ppm)			
Na		24000	11218
Ca		12228	10132
K		11588	18214
Mg		11242	6882
Cu		6.02	8.86
Pb		<0.02	0.8
Zn		56.8	108
Fe		2572	1186

ESTABLISHING STANDARD RECIPES FOR PRODUCING FOOD COMPOSITION DATA FOR THE SULTANATE OF OMAN

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Introduction

Oman is the second largest of the Gulf Cooperation Countries (GCC) with an area of 300,000 Km^2. According to the latest population census (1993) the population of Oman is about 2 millions. The country faced rapid transition since 1970, and consequently marked changes in socioeconomic status and food habits have occured.

There is no information on the composition of foods commonly consumed in Oman. The need for data on nutritive values of local foods has been emphasized by the Ministry of Health for therapeutic and educational purposes. An attempt was made here to establish standardized recipes to be used for food composition purposes in Oman.

Methods

The study was carried out into three phases:

1. Selection of the dishes

A rapid survey on 64 households from three geographical regions of Oman was carried out to obtain detailed information on common dishes consumed in this country. The regions were selected purposely based on their geographical and population characteristics. The sample included 20, 25 and 20 housesholds from the southern area, Muscat (the capital) and central (rural) areas respectively.

Housewives were interviewed by home economics students using a structured questionnaire to obtain data on main dishes consumed in Oman. The questionnaire contained information on main dishes commonly consumed by the households, dishes consumed at puerperium and dishes consumed in Ramadan (the fasting month for Muslims). Ingredients and methods of preparation of three dishes commonly consumed, two dishes consumed at puerperium and one dish consumed in Ramadan were also obtained.

About 60 dishes were mentioned and described by the housewives. Only 20 dishes were selected in this project as a first phase. The criteria for selection of the dishes were: consumed by large percentage of households, consumed on special occasions, and consumed by special ethnic groups.

2. Standardization of the dishes

The list of ingredients for each dish was obtained in each household. Then the average of each ingredient was calculated and used as a general guide for preparation of the recipe. The number and quantity of ingredients for the same dish were found to differ from household to household. For the purpose of this project, therefore, only the major ingredients were included in the recipes. Tables 1-3 illustrate examples of variation in ingredients in some selected dishes. This variation is due to several factors such as size of households, preferences, ethnic origin and geographical areas.

Table 1. Range in ingredients in meat curry (Saloonat Laham) (Total Sample = 16 Households)

Main Ingredients	No. Mentioned	Mean	Range
Meat	16	1.0	1/2-3 kg
Tomatoes	14	4.2	2-6 pieces
Potatoes	11	2.3	1-4 pieces
Onions	16	2.3	1-5 pieces
Garlic	12	4.6	1-10pieces
Eggplant	8	1.3	1-2 pieces
Oil	14	3Tbsp	1 1/2Tbs-1/2 cup
Ghee	2	1	1 Tbsp
Salt	16	0.9	1/2-1 Tbsp

Total ingredients included in the recipe = 25

Table 2. Range in ingredients in rice with meat (Machbous Laham) (Total sample = 13 Households)

Main Ingredients	No. Mentioned	Mean	Range
Rice	13	4.8	3-10 cups
Meat	13	1	1/2-1 kg
Onions	13	2.4	2-3 pieces
Tomatoes	13	3.8	2-9 pieces
Garlic	12	7	3-10 pieces
Water	13	5.6	4-7 cups
Oil	8	0.7	0.3-1 cup
Ghee	5	0.8	0.3-2 cups
Potatoes	3	2.3	2-3 pieces
Tomato Paste	3	1.3	1-2 pieces
Black lemon (Dried)	2	3.5	3-4 pieces

Total ingredients included in the recipe = 22

Table 3. Range in ingredients in fish curry (Saloonat Samek) (Total Sample = 19 Households)

Main Ingredients	No. Mentioned	Mean	Range
Fish	19	1.6	1-6 fishes
Onions	19	2.9	2-5 pieces
Tomatoes	17	3.2	2-5 pieces
Tomato paste	14	1.1	1-2 Tbsp
Oil	14	1.6	1-2 Tbsp
Ghee	5	4.8Tbsp	3Tbsp-1/2cup
Garlic	13	5.9	2-10 pieces
Salt	19	0.5	1.5Tbsp-2Tbsp
Coconut water	3	1.8	1.5-2 cups
Water	19	2.7	2-4 cups

Total ingredients included in the recipe = 33

3. Preparation of dishes

Dishes were prepared by an experienced housewife. Most ingredients were purchased from market of Oman. Other ingredients, namely meat and fish, were obtained from market of United Arab Emirates. All the ingredients were weighed carefully using a scale accurate to 1.00 gram. The dishes were prepared at least twice to adjust the recipe to common texture and flavour. This led to decreasing or increase the average of some ingredients to adjust the recipes. The final method of preparation was then adopted for each dish (see example in figures 1-3)

Figure 1. MACHBOUS LAHAM (Rice with Meat)

Ingredients

1	Cup rice
1/4 kg	Meat
1	Medium onion
1	Medium tomato
1	Hot green chilli
2	Pieces of garlic
2	Tablespoons of vegetable oil
1/2	Teaspoon mixed spices
1/4	Teaspoon turmeric
1	Teaspoon salt
3	Cups of water

Method

* Soak rice in one cup water for one hour.
* Brown onion in oil, add garlic and green chilli.

* Add tomato and mix until tender.
* Add spices, meat, water. Mix and leave at low heat until meat is tender.
* Add salt and rice. Mix and cook until rice is done.

Figure 2. MARRAGE DAJAJ (Chicken Curry)

Ingredients

1/4kg	Chicken
1	Medium onion
1	Medium tomato
2	Pieces of garlic
1	Medium potato
1	Medium eggplant
4	Pieces of okras
1	Small squash
1	Hot chilli
2	Tablespoons tomato paste
3	Tablespoons vegetable oil
1/4	Teaspoons mixed spices
1/4	Teaspoon black pepper
1/4	Teaspoon coriander
1/4	Teaspoon cumin
3/4	Teaspoon salt
2	Cups water

Method

* Brown onion in oil, add chicken and mix.
* Add garlic, tomato, tomato paste and other vegetables. Mix well, cook for 5 minutes.
* Add spices, salt and water. Bring to boiling. Cook at low heat until chicken is done.
* Serve hot with rice or bread.

Figure 3 MARRAG AL-SAMAK (Fish Curry)

Ingredients

1/2kg	fish
1	Medium onion
1	Medium tomato
1	Hot chilli
2	Pieces of garlic
2	Tablespoons fresh coriander
2	Tablespoons tomato paste
1	Medium potato
1	Lemon juice

Table 5. PROXIMATE AND MINERAL COMPOSITION OF SWEET SAMBOSA

Parameter		Sweet Sambosa
Proximate Composition		
Moisture %	w/w	9.77
Fat %	w/w	11.2
Protein %	w/w	7.52
Carbohydrates %	w/w	70.9
Ash %	w/w	0.57
Crude fibre %	w/w	Traces
Salt %	w/w	0.1
Calorific Value kcal/100g		414.5
Mineral composition (ppm)		
Na		123
Ca		128
K		1676
Mg		426
Cu		2.04
Pb		<0.02
Zn		7.49
Fe		25.5
P		279
Cd		<0.01

2	Tablespoons vegetable oil
3/4	Teaspoons mixed spices
1/2	Teaspoon turmeric
3/4	Teaspoon salt
1 1/2	Cup water

Method

* Brown onion in oil. Add tomato, tomato paste, chilli, garlic. Mix well
* Add potato, lemon juice, spices, salt and water, bring to boiling.
* Add fish, cook at low heat until done.
* Serve hot with rice or bread.

Difficulties Encountered

1. Lack of trained personnel for collecting reliable information on ingredients and method of preparation of dishes.

2. Differences in household measurements such as spoons and cups caused some difficulties in obtaining actual amount of ingredients.

3. Differences in size and weight of vegetables included in the recipes created some difficulties in estimating the size of vegetables used in preparation of the dishes.

4. Many housewives did not recall the actual amount of some ingredients. This is particularly true for the amount of water used in recipes.

5. Differences in ingredients and methods of preparation for the same dish mainly due to ethnic and geographical variations.

6. The average of ingredients did not provide the common texture and flavour when preparing the dish. Therefore, this average was used as a general guideline to adjust recipe to its common version.

Recommendations

1. Indepth surveys on dishes commonly consumed in Oman should be carried out with adequate and representative household samples. More emphasis should be given to variations in method of preparation according to geographical areas and ethnic groups.

2. A survey on size and measurements of kitchen utensils should be done to standardized these utensils.

3. It is preferable to standardize the size and weight of some vegetables and fruits. This can be done through grading these foods to three main sizes ; small, medium and large. An average weight of each size then can be used in all food composition purposes.

4. Dishes for chemical analysis should be prepared by local housewives and preferably from the geographical area and ethnic group that is related to the dishes.

5. Proper training should be done for those involved in collecting the data on ingredients and methods of preparation of the recipes.

EXPERIENCE OF KUWAIT IN ANALYSING LOCAL COMPOSITE DISHES

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Introduction

The need for food composition tables in the Arabian Gulf states, particularly for foods that have been handled, cooked and stored in accordance with customary procedures and practices, cannot be overemphasized. Earlier studies for assessment of the nutritional status of the Kuwaiti population indicated the deficiencies and limitations of published data on the nutritive values of locally-consumed foods (Mostafa and Nuwayhed, 1981; 1982; Eid and Al-Hooti, 1984). Although most of the raw foods in Kuwait and in other Gulf countries are imported and general data on their average compositions are available (Pellett and Shadarevian, 1970; Kamel and Allam, 1980, USDA, 1976-92; Musaiger and Al-Dallal, 1985), these food items are usually consumed as cooked dishes and are prepared differently. In Kuwait, prior attempts were made to establish nutrient composition tables of composite cooked dishes (Kamel and Allam, 1980; Al-Nesf et al., 1980). Kamel and Allam (1980) analyzed 35 cooked dishes for their proximate compositions and mineral contents, but no data were reported on vitamins or other nutrients. Al-Nesf et al. (1980) reported theoretical calculations on the compositions of 62 composite cooked dishes for proximate composition, minerals and vitamins; however, their values were overestimated because their calculations were based on the nutrient contents of raw ingredients, without accounting for moisture content, water added, or nutrients lost during cooking.

In other Gulf countries, data on the nutritive value of 20 Saudi Arabian composite dishes were reported, including proximate composition, nine minerals, nine vitamins, fatty acid and amino acid patterns, in vitro protein digestibility and cholesterol content (Al-Jebrin et al., 1983; 1985; Sawaya et al., 1985). In Bahrain, Musaiger and Al-Dallal (1985) reported a complete analyses of five Bahrani dishes and proximate analyses for another 38 dishes. However, the vitamin and mineral contents of these 38 dishes were theoretically computed.

Due to the fragmentary and incomplete information on the nutritive value of Kuwaiti foods, a joint project between the Ministry of Public Health (MPH) and KISR was undertaken to establish a national food composition table of the locally-consumed dishes. In Phase I of this project 16 composite dishes were studied and completed in 1989 (Eid and Al-Awadhi, 1989). In Phase II of this project 22 composite dishes were studied (Sawaya and Al-Awadhi, 1995) and data on the same will be reported here.

Materials and Methods

Preparation of Dishes

Twenty-two Kuwaiti dishes that are commonly consumed locally were selected for this study. Information on cooking procedures and on the ingredients and their quantities were collected based on a field survey of over 250 Kuwaiti households (of different income groups). The recipes were standardized by identifying the major ingredients of each recipe and their weight ratios of the total, and ensuring that the coefficient of variation (C.V.) of the major ingredients did not exceed 20%.

The cooked dishes, including seven meat-based, two chicken, two seafood, five sweets, one vegetable salad and five cereal dishes (Table 1), were prepared at the Ibn-Sina Hospital kitchen of the Ministry of Public Health, Kuwait City, Kuwait, based on the standardized recipes and under the supervision of experienced Kuwaiti cooks. All ingredients, including water, were weighed and three identical preparations of each dish were cooked separately and weighed. Each cooked dish was cleared of bones, homogenized and then sampled for moisture analysis. The remaining sample was freeze-dried (Virtis, Unitop 800L), ground and kept in tight bottle containers in a deep freezer (-18^{0}C) for further analysis.

The prepared dishes were nutritionally evaluated for their proximate composition (fat, protein, crude fiber, ash, moisture), caloric value, phytates, dietary fiber - soluble (SDF), insoluble (IDF), and total dietary fiber (TDF), fifteen macro and micro minerals (Na, K, Ca, Mg, P, Fe, Cu, Zn, Mn, Cr, B, Al, Se, I, Mo), water and fat-soluble vitamins (vitamins C, B1, B2, B6, B12, niacin, pantothenic acid, biotin, b-carotene, vit. A, vit. D, vit. E), fatty acid profile, cholesterol, amino acid profile, and protein quality, such as calculated protein efficiency ratio (C-PER), in-vitro protein digestibility and protein digestibility corrected-amino acid score (PDCAAS).

Nutrition Evaluation Study

Chemical Analysis

Proximate composition, including moisture, crude protein (Nx6.25), crude fat, ash and crude fiber were determined by standard procedures of the AOAC (1990). Carbohydrates were calculated by difference. Energy content was calculated by multiplying the protein, fat and carbohydrate values by the factors 4, 9 and 9, respectively. The phytates were determined according to Plaami and Kupulainen (1991) by separating the phytic acid in the sample extract and then concentrating by ion-exchange chromatography. The phytic acid concentration was then quantitatively determined as phosphorus by inductively coupled plasma atomic emission spectrometry (ICP-AES).

Dietary Fiber Analysis

Soluble (SDF), insoluble (IDF) and total dietary fiber (TDF) were determined by an enzymatic-gravimetric method according to Prosky et al. (1988,1992). The dietary fiber value reported is the sum of the SDF and IDF.

TABLE 1.

Ingredients and Cholesterol Contents of Kuwaiti Dishes (mg/100 g edible portion)

Code	Dish	Ingredients
M1	Warag Enab	Grape Leaves, Sweet Pepper, Rice, Tomato, Onion, Minced Meat
M2	Mahshi Bil Koosa	Zucchini, Rice, Tomato, Onion, Minced Meat, Sweet Pepper, Parsley
M3	Kofta	Minced Meat, Onion, Parsley, Tomato
M4	Gabbout	Brown Flour, Meat, Tomato, Onion
M5	Marag Shabzi	White Beet, Leek, Coriander, Tomato, Meat, Onion, Green Beans
M6	Qouzi	Lamb, Rice, Onion, Boiled Eggs
M7	Tashreeb	Meat, Bread, Potato, Tomato, Onion, Gourd, Tomato Paste
C1	Biryani	Rice, Chicken, Potato, Sweet Pepper, Onion, Tomato, Carrot
C2	Dajaj Belferen	Chicken, Tomato, Potato, Carrot, Onion
F1	Hameset Rubyan	Shrimp, Coriander, Tomato, Onion, Garlic
F2	Samak Mashwi	Fish, Dates, Onion, Garlic, Coriander
S1	Balaleet	Vermicelli, Eggs, Sugar, Oil
S2	Qours Okaili	Brown Flour, Eggs, Milk, Sugar, Rose Water, Oil
S3	Rangena	White Flour, Dates, Butter
S4	Tamrea	White Flour, Dates, Butter
S5	Elba	Raw Eggs, Powdered Milk, Sugar
V	Mixed Salad	Cucumber, Tomato, Sweet Pepper, Carrot, Parsley, Lettuce
CB1	Mashkoul	Rice, Onion, Oil, Salt
CB2	Khoubiz Ragag	Brown Flour, Fat, Salt
CB3	Khoubiz	Brown Flour, Sesame, Yeast
CB4	Macaroni Bil Bashamel	Macaroni, Minced Meat, Onion, Tomato, White Flour, Eggs, Milk, Butter
CB5	Mashkoul Bil Bathengen	Rice, Aubergine, Onion, Potato, Tomato

Cholesterol and Fatty Acid Analyses

Cholesterol was determined quantitatively by gas-liquid chromatography (GLC) (HP 5890) according to the procedure outlined in the method of AOAC (AOAC, 1984). Fatty acids were analyzed by GLC as their methylesters according to Aziz and Abu-Daga(1991) with modifications.

Mineral Analysis

For the determination of sodium, potassium, calcium, phosphorus, magnesium, iron, zinc, copper, manganese, boron, chromium, aluminum and molybdenum, about 1.0g of sample was digested with nitric and perchloric acid mixture. The final solution was taken in 1% nitric acid. The analyses were done by using inductively-coupled plasma-optical emission spectrometry (ICP-AES, Jobin-Yvon model JY-24) and results (ppm) were evaluated from calibration of the method using metal-mixed standard (E-Merck, Germany). Selenium was analysed using hydride generation atomic absorption spectrometry (Varian Plus). The accuracy of the methods used was checked by analyzing certified reference standards with the samples, for example: wheat flour standard (SRM 1567a); oyster tissue (SRM 1566a); bovine liver (SRM 1577b); and tomato leaves (SRM 1573). Iodine was analyzed calorimetrically according to AOAC (1990), Binerts (1954) and Heerspink and Deweegh (1972).

Vitamin Analysis

b-carotene (pro-vitamin A), vitamin A, thiamin hydrochloride (thiochrome method), riboflavin, niacin, pantothenic acid and vitamin B12 were assayed by procedures outlined in AOAC (1990) and the U.S. Pharmacopeia (1990). Assays were done for pyridoxine hydrochloride (AOAC, 1990; Atkins et al., 1943), folacin (Hurdle et al., 1968), biotin (Wright and Skeggs, 1944; Sheiner and De Ritter, 1975). vitamin D (AOAC, 1990; Thompson et al., 1982), vitamin E (Cort et al., 1983; Speek et al., 1985; McMurray et al., 1980) and vitamin C (Deutsch and Weks, 1965; AOAC, 1990). The data for vitamin A included chemically determined preformed vitamin A and provitamin-A (b-Carotene). Vitamin A activity was expressed in International Units (IU). One IU was equivalent to 0.3 ug retinol (vitamin A). The concentration of b-carotene was also expressed in IU. One IU was equivalent to 0.6 ug of b-carotene. For the dishes, the vitamin A activity was converted to retinol equivalent (RE), with 1.0 RE equivalent to 3.33 IU of all-trans retinol or 10 IU of all-trans b-cartoene. Vitamin E was calculated as IU and expressed as mg alpha tocopherol equivalent (mg TE/100 g). One mg of Dl-alphatocopherol = 1.10 IU of vitamin E. Vitamin D was reported as IU/100g. One IU of vitamin D was defined as 0.05 ug of cholecalecalciferol or the biological activity of cholecalciferol = 40 IU/ug.

Amino Acids Analyses

Samples of 2-5 mg protein were hgydrolyzed by 6N HCI for 24 h at 110^0C (Moore and Stein, 1963). Cystine was determined as cysteric acid by performic acid treatment of the sample (Moore, 1963) and then hydrolyzed as earlier. Tryptophan was released by the alkaline hydrolysis (NaOH) procedure of Hugli and Moore (1972). All the hydrolyzates were determined on a Beckman 121 amino acid analyzer. The chemical score was calculated by dividing the contents of essential amino acids in the test protein by the contents of the same amino acid requirement pattern of the WHO (1985). The amino acid with the lowest score was considered the limiting essential amino acid.

In Vitro Protein Digestibility and Calculated Protein Efficiency Ratio (C-PER)
The IVPD of the protein of each dish was estimated by the multi-enzyme procedure of Hsu et al. (1977) and modified procedure of Saterlee et al. (1979). The C-PER was calcuated from the data of the essential amino acids and IVPD as described by Saterlee et al. (1979).

Protein Digestibility Corrected Amino Acid Score (PDCAAS)
The PDCAAS of the composite dishes was calculated by multiplying the lowest amino acid score by protein digestibility as described by the FAO/WHO (1989). Corrected scores above 1.00 are considered as 1.00 or 100%.

Statistical Analysis
Statistical analysis for the standard deviation and coefficient of variation were performed by computer using the "Statistical Analysis System" (SAS) (1985).

Summary of Findings

Chemical Composition and Protein Quality
The chemical composition and nutritional quality of 22 Kuwaiti composite dishes were investigated. (Table 2). On a fresh weight basis, the dishes contained 13.9-91.6% moisture, 0.91-18.1% protein (Nx6.25), 0.2-16.4% fat, 0.00-0.8% crude fiber, 0.8-4.6% ash, 4.5-73.9% carbohydrates, 165.6-1556.8 kJoules (39.6-372.1 Cal) and 0.014-0.37% phytates. The essential amino acids most deficient in the dishes were mostly tryptophan (18 dishes) or lysine (one dish) or total sulphur amino acids (M + C, in one dish) (Table 3). The chemical scores ranged between 15-96 (FAO/WHO, 1989). The in-vitro protein digestibility (IVPD) calculated protein efficiency ratio (C-PER), and protein digestibility corrected amino acid score (PCDAAS) values, ranged between 73.4-90.0%, 0.61-2.91 and 0.13-0.84, respectively. Under identical conditions, the Animal Nutrition Research Council casein showed IVPD, C-PER and PDCAAS values of 90%, 2.5 and 1.00 respectively.

The IVPD values, in general, are close to those reported for cereal and meat-based products (FAO, 1970). The lower C-PER values for some of the dishes, e.g., S3, S4, M7, M2, are in the line with low chemical scores of these dishes. The C-PER of the remaining dishes are comparable with data of FAO (1970). These data suggest that dishes S3, S4, M2 and M7, despite these good digestibility, have a lower nutritional quality, where as other dishes, especially M1, F1, S5, have reasonably good protein digestibility and nutritional quality. Despite certain variations, it is observed that the low C-PER values correspond to low PDCAAS irrespective of the digestibility values. The digestibility values of these composite dishes are considered fairly reasonable and are relatively higher than the values for true digestibility of protein in the diets from developing countries (Sarwar, 1987; Hopkins, 1981), suggesting that protein digestibility is of lesser concern in the Kuwaiti composite dishes, and that the lower amino acid scores become the concern. The low amino acid score values may have been due to the effect of the methods of handling and processing/cooking used,

which destroys, to some extent, the heat-sensitive amino acids such as tryptophan, which is the most deficient amino acid in these dishes.

Dietary Fiber

Analysis of the dietary fiber showed that the IDF was the major dietary fiber fraction in all dishes (Table 4). The average content of IDF in all the dishes was 3.72 g/ 100 g fresh weight compared with 1.00 g/ 100 g for the SDF fraction. The mean content of TDF was highest in the sweet dishes (4.67), particularly those containing dates, followed by the cereal-based dishes (3.86) containing all-wheat flour. The meat (3.44) and chicken-based dishes (2.72) contained moderate levels of TDF, with the vegetables in the recipes contributing most of the TDF in these dishes; however, most of the dishes contained 2-4 g dietary fiber /100 g fresh weight, and hence can be considered moderate sources of dietary fiber.

Data on food consumption intake of the different age groups of the population in Kuwait are still lacking; however, typical individual portions of these composite dishes (average TDF of the 22 dishes = 3.72 g/100 g) ranging from 300 to 400 g will supply about 11.2 - 14.9 g/100 TDF, which is considered as a moderate source of dietary fiber (CACDF, 1985). The consumption of other food items, including bread, will also add to the TDF intake.

Fatty Acids and Cholesterol

The cholesterol content of the dishes (mg/100 edible portion) (Table 5) ranged from trace levels to 96. The shrimp-based dish (95.9) and sweets (Elba) rich in eggs (85.3) contained the highest levels. These were followed by the lamb meat-based dishes, kofta (61.2), fish (44.0) and chicken-based dishes (37.7). Other dishes contained lower amounts of cholesterol (between 0.17 - 13.8 mg/100g). Whereas palmitic and stearic acids were the predominant saturated fatty acids, cis-oleic acid was the major monounsaturated fatty acids . Only one dish, CB2 (flaked bread), contained relatively high levels of trans 18:01 fatty acid (Table 5). The ratio of the polyunsaturated- to-saturated -to-monounsaturated (P:S:M) fatty acids in almost 50% of the dishes was substantially higher than the 1:1:1 ratio recommended, particularly with respect to the saturated fatty acids (Table 8). The P:S ratio in these same dishes were also low, i.e. , less than 0.5, with the ratio 1:1 being recommended as the most desirable.

Minerals and Vitamins

The concentration of 14 mineral elements and 11 vitamins in the 22 dishes are presented in Table 6 and 8. Except for very few high values in the levels of certain minerals and vitamins, results indicated the following concentrations (mg/100g): sodium 2-910, potassium 21-621, calcium 13-522, phosphorus 17-357, magnesium 11-103, iron 0.2-4.12, copper 0.08-0.40, manganese 0.13-2.65, boron 0.0-0.9, chromium <0.05-0.09, aluminum <0.05-1.82, iodine <0.01-0.28 and selenium 0.008-0.0627. The concentrations of the vitamins were: Vitamin A traces -207 retinol equivalent/100, vitamin D traces-156 I.U., vitamin E traces-2.1mg a-tocopherol/100g, vitamin C traces-6.3 mg/100 g, thiamin 0.008-0.183 mg/100 g, riboflavin 0.023-0.855 mg/100 g, pantothenic acid 0.113-1.356, biotin 0.001-0.009 mg/100g, folacin T-61.689 u/100 g and vitamin B12 T-1.321 ug/100 g.

Table 2. Chemical Composition (g/100g Edible Portion) and Phytate Conent (mg/100 g Edible Portion) of Kuwaiti Composite Dishes

	M	C	F	S	V	CB	Lowest	Highest
Moisture	46.70-78.33 (68.38)*	64.59-67.75 (66.17)	63.35-74.13 (68.74)	15.56-52.10 (34.02)	91.60 (91.60)	13.88-66.54 (46.42)	CB2	V
Ash	1.42-3.03 (2.07)	1.35-2.23 (1.79)	3.93-4.55 (4.23)	0.80-2.38 (1.37)	0.85 (0.85)	0.81-2.21 (1.42)	S1	F1
Fat	0.91-16.38 (6.41)	4.29-4.91 (4.60)	3.64-6.78 (5.21)	4.81-11.15 (8.67)	1.98 (1.98)	0.18-5.03 (2.82)	CB2	M6
Protein	4.87-18.06 (8.92)	7.45-12.33 (9.89)	10.74-17.88 (14.31)	3.11-11.29 (6.91)	0.93 (0.93)	2.91-12.71 (7.59)	V	M3
Crude Fiber	0.08-0.26 (0.16)	0.09-0.17 (0.13)	0.07-0.11 (0.09)	0.00-0.26 (0.17)	0.13 (0.13)	0.26-0.77 (0.52)	S5	CB3
Carbohydrate	4.51-24.27 (14.10)	12.69-22.15 (17.42)	6.87-7.95 (7.41)	30.61-73.86 (48.87)	4.51 (4.51)	20.00-70.28 (41.23)	M3 & V	S4
KJ	361.36-1203.32 (626.21)	603.61-656.95 (630.28)	431.72-687.58 (559.65)	887.04-1556.76 (1260.05)	165.64 (165.64)	621.54-1395.65 (923.27)	V	S3
Kcal	86.37-287.60 (149.67)	144.27-157.01 (150.64)	103.18-164.34 (133.76)	212.01-372.07 (301.16)	39.59 (39.59)	148.55-333.57 (220.67)	V	S3
Phytate	42.06-103.82 (76.55)	57.16-85.67 (71.42)	126.16-369.76 (247.96)	43.96-236.74 (116.63)	14.27 (14.27)	45.84-315.90 (161.78)	V	F1

*Numbers in parentheses are averages

Table 3. Protein Quality of Kuwaiti Composite Dishes

	M	C	F	S	V	CB	Lowest	Highest
Amino Acid Score	37-99 (70.86)*	55-75 (65.00)	74 (74.00)	15-67 (39.00)	60 (60.00)	48-85 (61.20)	S3	M3
IVPD	77.4-84.8 (80.56)	80.3-80.7 (80.50)	79.5-80.3 (79.90)	82.6-90.0 (85.26)	73.4 (73.40)	77.2-88.3 (83.04)	V	S1
CPER	1.01-2.67 (2.04)	1.77-2.31 (2.04)	2.3-2.55 (2.43)	0.61-2.91 (1.80)	2.11 (2.11)	1.31-2.12 (1.79)	S3	S5
PDCAAS	0.29-0.81 (0.55)	0.44-0.68 (0.56)	0.59-0.80 (0.70)	0.13-0.84 (0.54)	0.44 (0.44)	0.40-0.66 (0.51)	S3	S5

*Numbers in parentheses are averages

Table 5. Cholesterol (g/100g Edible Portion) and Fatty Acid Profiles of Kuwaiti Composite Dishes

	M	C	F	S	V	CB	Lowest	Highest
Cholesterol	6.77-61.16 (24.43)*	12.49-37.74 (25.12)	44.02-95.91 (69.97)	13.01-85.28 (45.54)	0.17 (0.17)	0.80-13.82 (2.92)	V	F1
SFA	37.08-50.51 (45.13)	21.45-36.73 (29.09)	21.36-54.81 (38.09)	24.18-72.45 (52.36)	16.80 (16.80)	15.53-64.55 (29.84)	CB5	S4
MUFA	36.85-41.13 (39.04)	33.32-44.32 (38.82)	24.44-31.51 (27.98)	20.13-28.65 (24.16)	71.72 (71.72)	25.79-31.20 (28.33)	S3	V
PUFA	5.53-22.82 (11.58)	15.18-43.39 (29.29)	9.28-44.88 (27.08)	3.01-44.19 (18.26)	8.22 (8.22)	4.05-56.60 (39.8)	S4	CB5

*Numbers in parentheses are averages

Table 6. Mineral Content of Kuwaiti Composite Dishes (mg/100g Edible Portion)

	M	C	F	S	V	CB	Lowest	Highest
Na	230.48-674.58	215.08-321.61	688.95-909.58	2.40-141.16	101.25	76.51-397.2	S3	F1
K	154.77-351.50	174.92-346.16	192.96-346.83	63.84-621.00	83.11	21.20-239.61	CB1	S4
Ca	17.21-139.29	34.50-41.58	41.90-72.48	28.46-522.47	36.16	12.97-55.94	CB1	S5
Mg	11.79-32.24	29.74-41.80	26.58-38.90	34.55-90.54	13.3	11.00-103.22	CB1	CB3
P	57.47-144.67	17.12-103.12	190.20-236.53	51.39-356.83	41.51	43.10-257.82	C2	S5
Fe	0.21-4.12	1.39-1.93	1.74-2.39	1.08-2.09	0.39	0.84-6.81	M7	CB3
Cu	0.08-0.14	0.08-0.09	0.05-0.10	<0.05-0.19	0.4	0.08-0.31	S5	V
Mn	0.13-0.40	0.13-0.34	0.13-0.22	0.23-1.45	0.1	0.29-2.65	V	CB2
Zn	0.60-3.28	0.93-1.13	0.68-0.71	0.46-1.77	0.18	0.54-2.04	V	M3
Cr	<0.05	<0.05	<0.05	<0.05-0.09	<0.05	<0.05	M, C, F, S1, S2, S3, S5, V & CB	S4
Al	0.18-1.48	0.37-0.39	0.62-1.82	<0.05-0.56	0.12	0.09-0.38	S1, S2 &S3	F1
B	<0.05-0.25	0.06-0.09	0.13-0.14	<0.05-0.90	0.16	<0.05-0.74	M1, M2, M3, M4, M7, S4, S5, CB3 &CB4	S1
I	<0.01-0.06	<0.01-0.04	0.04-0.19	<0.01-0.28	0.05	<0.01-0.02	M1, M2, M6, M7, C1, S3, S4, CB1, CB2, CB3 &CB5	S5
Se (μ /100g)	2.66-7.56	11.48-13.28	27.19-37.56	7.78-53.33	0.76	4.87-62.78	V	CB3
Mo	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.		

In Tables 7, 8 and 9, data are presented on the RDAs of the Food and Nutrition Board (NRC, 1989) and contribution of the dishes to the RDA of various minerals and vitamins for adult individuals (19-24 years of age). Except for a few high values for some of the minerals and vitamins in some dishes, generally,a 100 g serving of the different dishes can approximately contribute: 1-12% to the RDA of Ca and 1-30% of P for both sexes; 1-29% of Mg for males and 4-37% for females; 2-41% of iron for males, 1-27% for females; 1-17% for Zn for males and 2-22% for females; 0.188% of I for males and females; and 1-90% of selenium for males and 1-114% for females (Table 7).

Among the vitamins, the same amount of each dish can meet: 2-26% of the RDA of thiamine for males and 1-35% for females; 1-11% of riboflavin for males and 2-14% for females; 1-10% of pyridoxine for males and 2-13% for females; 1-28% of niacin for males and 1-36% for females; traces to 20% of folacin for males and traces to 22% for females; traces to 37% of vitamin B12; traces to 20% of vitamin C, traces to 7% of vitamin D, traces to 21% of vitamin E for both males and females; and traces to 36% of vitamin A for males and traces to 45% for females (Table 9).

No RDAs are set for some of the minerals and vitamins studied here, but estimated safe and adequate daily dietary intakes have been suggested. Based on the minimum recommended levels (NRC, 1989), a 100g serving of these dishes will furnish 0.1-74% of sodium, 1-34% of potassium, ND-21% of copper, 6-133% of manganese, ND-160% of chromium, 3-34% of pantothenic acid and 3-30% of biotin for both sexes. Although the levels of the mineral elements in the diet are important, but more important is the bioavailaility of these elements to the body. For example, while heme iron, available in animal tissues, is highly absorbable, non-heme iron, mostly in vegetable products, is absorbed to a much lesser extent; however, the absorption of non-heme iron can be enhanced in the presence of some organic acids (Especially ascorbic acid) (Gillooly et al., 1983) and the animal tissues present in each meal (Cook and Monsen, 1976), and is decreased by phytates, brans or polyphenols such as in tea and antiacids (gillooly et al., 1983; Monsen et al., 1978). Minerals could also be chemically bound to phytic acid in the raw cereals and legumes and may not be all available to the body; however, cooking is reported to destroy phytates mainly by heat application (Oberleas, 1973), causing a greater availability of mineral elements in the cooked food than in the raw materials. Similarly, the bioavailability varies widely for different vitamins based on their interaction with the chemical compounds and /or inhibitors, which may make them less available for absorption, on the status of the vitamin stores or on the saturation of the intrinsic factors for the absorption of some vitamins (NRC, 1989).

Based on the data obtained and its nutritional significance, the dietary fiber content of the 22 composite dishes investigated indicates that most of them contain 2-4 g dietary fiber/100g fresh weight, i.e., moderate sources of dietary fiber; however, divergent serving sizes may increase the variation of the dietary fiber intake of 20-35 g/d can possibly be met by consuming a wide variety of foods and might not be a far-fetched

goal in a county like Kuwait, with a great abundance of food, particularly fruits and vegetables, all the year round, and the traditional eating habits of wheat bread. But in the absence of food consumption data, any projects on the intake of TDF by the population will not be accurate, and thus warrants the necessity for generating such data.

When viewed in light of the general agreement among nutritionists that a high dietary fat intake coupled with low fat quality, e.g., a low P:S ratio, can raise the serum cholesterol and affect negatively other several CHD risk markers (Snadstrom, 1993), the nutritional significance of these results become clear. Since most of the commonly-consumed dishes investigated have a low P:S ratio, there is a need for dietary manipulations, such as modification of the fat composition of the whole diet towards higher P:S ratio by partial substitution of animal fats with vegetable oils such as corn oil. There is also a critical need for generating data on the food consumption pattern of the population, without which the actual dietary fat intake of the different age groups in the population cannot be calculated. Such information will be helpful in studying the relationship between the nutritional factors and etiology of CHD and / or other nutrition related diseases in Kuwait. Moreover, and based on these results and on the shortcomings of data in the literature on the bioavailability of minerals and vitamins in cooked foods, it becomes critical to generate data on the bioavailability of minerals in cooked dishes as well as on the retention of vitamins and amino acids as affected by the cooking and/or traditional methods used in the preparation of these dishes. Such data are still lacking and will be most useful in studying the relationship between the nutritional factors and etiology of nutrition-related diseases in man, particularly in Kuwait and other other GCC countries.

Obstacles in Preparation of Samples, Analyses and Presentation of Data

Obstacles faced during the preparation, analyses and presentation of data are briefly cited below:

1.Preparation of Cooked Dishes

a. Selection of ingredients was dictated by the availability of the same in the market, particularly the vegetables (source based on season).
b. Seasonal variations (source, brands and cultivars, storage/preservation conditions), were difficult to control due to the market's dynamics.
c. Choice of ingredients, particularly vegetables and fruits, could not be standardized; it was however based on the element of freshness and wholesomeness, based on the physical appearance of the raw material/product. Chicken, meat and eggs (major brands) used were from well-known local suppliers. Fish was bought fresh from the fish market.
d. Variation in the nutritive value of cooked dishes cooked by different cooks using the same recipe, was observed in earlier preliminary studies. To avoid this problem, cooked dishes under investigation were prepared by two different cook teams, and each dish was nutritionally evaluated in duplicate.

e. Effect of cooking procedures/methods traditionally used on the retention of certain vitamins and leaching of minerals could not be carried out in the first and second phases of this project. However, such study will be conducted in the third phase of this project that will include 30 more dishes.

f. Homogenizing the samples proved to be a delicate and tough task. Special attention is needed for the separation of bones from the sample in order to avoid discrepancies in the analytical results, particularly Ca and P. With sweet dishes containing dates as a major ingredient, homogenizing of the sample presents a serious problem. This will require the right homogenizer, e.g. Robot-cop and the appropriate portioning.

2. Analyses

At KISR, we do have an excellent experimental set-up for the chemical and microbiological analyses of foods. This include state of the art laboratories with a well-established chromatography section (several GCS, HPLC, GC-MS, GL/LC-MS-MS and complementary equipment, Spectroscopy section).

So most of the obstacles we faced during the course of work were procedural which we were able to solve and cannot thus be considered as major obstacles. In brief, such problems included the following:

Dietary Fiber: Clogging and/or seepage of sample from the filtration flasks and sticking of the digestate to the bottle walls, which causes loss of weight.

Phytic Acid: using the phytic acid phosphorus to assay for the content of phytic acid in the sample, the precipitation with ferric hydroxide yielded <50% recovery. Using an ion exchanger instead proved the recov ery to almost 100%.

Vitamin Analyses: For fat-soluble vitamins, using superfluid extraction (SPE) by liquid CO2 improved considerably the recovery of the vitamins from the sample matrix. Some of the HPLC methods for the analysis of water-soluble vitamin considered to be much more easier and even more accurate than the certified methods in the literature, are still not certified. If GC-MS-MS is available, it might provide a very good alternative to the determination of vitamin B12 in foods. Work on the same is under investigation in our labs.

Amino Acid Analysis: In alkaline hydrolysis, high-sugar content samples usually become viscous after hydrolysis and may cause a problem in filtration.

In-vitro Protein Digestibility: The change of the pH of the slurry (sample plus buffer) is very sensitive and errors can be easily made if not carefully controlled.

Table 7. Percent Recommended Dietary Allowances (RDAs) of Minerals From 100g Dish (Fresh Weight)

	M	C	F	S	V	CB	Lowest	Highest
Na	12-28	9-13	29-28	0.1-6	4	9-74	S3	CB5
K	9-20	10-19	11-19	4-34	5	1-13	CB1	S4
Ca	1-12	3	3-6	2-44	3	1-5	M2, CB1 & CB5	S5
P	5-12	1-9	16-20	4-30	3	4-21	C2	S5
Mg (M)	3-9	8-12	8-11	10-81	4	32-29	M1 & CB1	S5
(F)	4-12	11-15	9-14	12-102	5	4-37	M1 & CB1	S5
Fe (M)	2-41	14-19	17-24	6-21	4	9-68	M4 & M7	CB3
(F)	1-27	9-13	12-16	4-14	3	6-45	M7	CB3
Zn (M)	6-17	6-8	5	3-12	1	4-14	V	M6
(F)	8-22	8-9	6	4-15	2	5-17	V	M6
Cu	5-9	5-6	3-7	7-13	3	5-21	F2 & V	CB3
Mn	7-21	7-17	7-11	13-73	6	15-133	V	CB2
Cr (μg)	N.D.	N.D.	N.D.	160	N.D.	60	CB5	S4
I (μg)	17-42	24	29-124	8-188	34	13	S1	S5
Se (M)	4-11	16-19	39-54	11-76	1	7-90	V	CB3
(μg) (F)	5-14	21-24	49-68	14-97	1	9-114	V	CB3

Table 8. Vitamin Content of Kuwaiti Composite Dishes/ 100 g Edible Portion

	M	C	F	S	V	CB	Lowest	Highest
Vitamin C (mg)	T-2.910	0.697-6.304	T-2.836	T-1.125	11.874	T-1.119	M4, M6, F2, S1, S2, S3, S4, CB1, CB2, CB3 & CB4	C2
Thiamine (B1) (mg)	0.027-0.087	0.055-0.093	0.048-0.137	0.008-0.183	0.047	0.008-0.384	M6	CB3
Riboviavin (B2) (mg)	0.050-0.188	0.059-0.093	0.078-0.170	0.063-0.855	0.04	0.023-0.129	CB5	S5
Pyridoxine (B6) (mg)	0.052-0.112	0.105-0.167	0.098-0.121	0.056-0.134	0.09	0.024-0.206	CB1	CB2
Niacin (mg)	1.441-4.534	2.550-5.342	0.570-3.724	0.309-1.382	0.533	0.114-2.814	CB1	C2
Pantothenic acid (mg)	0.214-0.461	0.294-0.843	0.128-0.621	0.459-1.356	0.113	0.173-0.632	V	S5
Biotin (mg)	0.001-0.003	0.001-0.002	0.003-0.005	0.001-0.009	0.001	0.001-0.005	M7, C1, S3, S4, V, CB1 &CB5	S5
Vitamin B12 (mcg)	0.309-1.321	0.136-0.322	0.530-1.210	T-1.305	T	T-0.205	S4, V & CB5	M3
Folacin (mcg)	7.928-61.689	7.266-13.636	16.901-32.344	10.020-31.526	18.165	T-22.510	CB1	M5
Vitamin A (R.E)	T-95.300	96.500-117.500	44.300-65.600	T-206.649	120.5	T-39.455	M4, M6, S1, CB1, CB2 &CB3	S5
Vitamin D (IU)	T	T	T-29.500	T-156.400	T	T	M, C, F1, S1, S2, S3, S4, V, CB	S5
Vitamin E (IU)	T-0.750	0.198-0.653	0.940-2.108	0.499-2.918	0.569	0.180-1.161	M3, M4, M6, M7	S2

Table 9. Percent Recommended Dietary Allowances (RDAs) of Vitamins From 100g Dish (Fresh Weight)

	M	C	F	S	V	CB	Lowest	Highest
Thiamine (B1) (M)	3-6	4-6	3-9	1-13	3	3-35	S1 &CB1	CB3
(mg) (F)	2-8	5-8	4-12	1-17	4	4-35	S1 &CB1	CB3
Riboviavin (B2) (M)	3-11	3-5	5-10	4-50	2	1-8	CB5	S5
(mg) (F)	4-14	5-7	6-13	5-66	3	2-10	CB5	S5
Pyridoxine (B6) (M)	3-7	5-8	5-6	3-7	5	1-10	CB1	CB2
(mg) (F)	3-8	7-10	6-8	4-8	6	2-13	CB1	CB2
Niacin (M)	8-24	13-28	3-20	2-7	3	1-15	CB1	C2
(mg) (F)	10-30	17-36	4-25	4-8	4	1-19	CB1	C2
Folacin (M)	4-31	4-8	8-16	5-16	9	T-20	CB5	M5
(mcg) (F)	4-34	4-9	9-18	6-18	10	T-22	4, C1, CB4 &CB	M5
Pantothenic acid (mg)	5-12	7-21	3-16	11-34	3	4-16	F1 & V	S5
Vitamin B12 (mcg)	15-66	7-16	27-61	T-65	3	T-10	S4, CB1, CB5	M3
Biotin (mcg)	7-10	3-7	10-17	3-30	3	3-17	M7, C1, S3, S4, V, CB1 & CB5	S5
Vitamin C (mg)	T-5	1-11	T-5	T-2	20	T-2	M4, M6, F2, S1, S2, S3, S4, CB1, CB2, CB3, CB4	V
Vitamin D (IU)	T	T	T-7	T-39	T	T	M, C, F1, S1, S2, S3, S4, V, CB	S5
Vitamin E (IU)	T-7.5	T-7	9-21	5-29	6	2-12	M3, M4, M6, M7	S2
Vitamin A (M)	T-29	29-31	9-13	T-22	36	T-5	M4, M6, S1, CB1, CB2, CB3	V
(R.E.) (F)	T-36	36-39	11-17	T-28	45	T-6	M4, M6, S1, CB1, CB2, CB4	V

3. Quality Assurance

For checking the accuracy of the result, the following approach was followed: i) use of certified reference material similar to the sample, e.g. for mineral analyses - wheat flour standard (SRM 1567a), oyster tissue (SRM 1573); ii) spiking the sample with stocks of known amounts of standard and studying recoveries; iii) comparing the values with the values obtained by another validated method, e.g. HPLC vs GC or Atomic Absorption vs ICP-OES; iv) collaborative analysis with research centers in different countries. For the precision of the method, it was checked by replicate analysis of lab-made standards from pure analyte and then statistically analyzed so that at the 95% confidence interval, the result should be $X \pm 2$ SD.

Obstacles faced during the course of work, were the unavailability of certified references for all of the parameters studied. At present, we are in the process of contacting different labs in the world to explore the possibilities for obtaining certified reference material and or participate in collaborative studies relevant to our work.

4. Presentation of Findings

After a lot of thought, we found out that the USDA new version of the Handbook No.8, now 1-23, was the most appropriate approach for the presentation of the findings. The only difference was that only the amount of 100g edible portion was reported and the amount in g/1b was not reported. Having said this, the main problem we faced was the grouping of the individual dishes into sections and the numbering system which should allow enough flexibility to add future data without disrupting the existing data and necessitating the reprinting of the book each time data on new dishes become available. Based on the aforementioned, the food composition tables, which are now in print, are arranged as follows:

A three string plastic file instead of a regular book. Data on each dish is presented separately, with the recipe (ingredients and weight of each) on one page and the nutritive value on another page.

The 38 dishes were divided into seven categories based on the major ingredients, e.g. meat-based, chicken-based, etc. Numbering of each section was done on a serial basis, but the serial system was followed only on each section separately. This would allow to add more data for additional dishes in the future, each in its own section, thus avoiding the need to reprint the book every time a new data become available.

Time and effort for printing the book was very much underestimated.

Users of Food Composition

The potential users of the "Kuwaiti Food Composition Tables" are:

Government Ministries/Agencies:

Ministries of Health, Education, Planning, Commerce and Industry, Social Affairs, Information and Defense.

Educational Institutions
Kuwait Institute for Scientific Research
Kuwait University
College of Applied and Health Sciences
Secondary/Primary Schools.

Food Industry
Hospitals/Private and Public
Citizens and Residents
Other GCC countries.

Recommendations

Establishment of "Food Composition Tables" for the GCC countries, with a stress on the most-commonly consumed foods/composite dishes, and development of the mechanisms for the:
- Development of a GCC Food Composition Database including all logistics for the exchange of information among the GCC countries and the rest of the world.
- Conducting of periodical meeting/symposiums on the level of GCC/Arab World for the exchange of ideas/experiences and accomplishments
In order to accomplish the above, the following are needed as a first step towards the achievement of the overall goal of establishing "Food composition Tables" for the GCC countries:

a) Forming a committee representing the GCC countries to coordinate the work on the same, including:
   - Preparation of standard guidelines for the collection and/or preparation of samples.
   - Standardization of the methods of analyses
   - Preparation of standard samples for quality control/quality assurance
   - Coordination of collaborative studies among assigned/agreed upon research centers/labs in the different GCC countries
   - Development of standard formats for the presentation of results
   - Development of an operating manual for the use of data bases.

b. Assignment of focal points/centers in each GCC country to coordinate the work on food composition on the national level.

c. Assign a lab/research unit in one of the GCC countries as the center for coordinating the work on "Food Composition" among the GCC countries.

d. Secure the financial support logistics needed to carry out this task.

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COMPOSITION OF CAMEL MILK AND MEAT: EXPERIENCE OF FOOD AND ENVIRONMENT CONTROL CENTER.

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Introduction

The total population of camels in the world is about 17.5 million, of which 12.4 million are in Africa and 4.1 million in Asia (FAO, 1984). There are two different species of camels belonging to genus camelus, namely the Dromedary Camel (*Camelus Dromedrius* one-humped) and Bacterian (*Camelus Bacterianus* two-humped). Camels in Africa and the Middle East are dromedaries while those in Asia are Bacterians.

Camels in the United Arab Emirates (70,000) are all dromedaries of the Arabian breed. They play a major role in the economic life and survival of the desert dwellers and are a major source of protein and energy for them. Camel racing has become very popular in the urban areas and many countries now in the Middle East encourage this sport.

Unlike other milk producing animals, the camel can thrive under extreme hostile conditions of temperature, drought and lack of pastures and can still produce milk of high nutritional quality (Yagil and Etizion, 1982). A typical camel, for instance, can yield 3,500 or more litres of milk during a lactation period which can extend for 18 months or even longer. The protein and energy content of the milk is usually good and can average some 35 gram protein and 3000 kilojoules of energy per litre.

Camel meat has tough muscle fibers and a sweet flavour. The fat is mostly concentrated in the hump. There is often some resistance to the consumption of camel meat, particularly in developing countries in which camel meat might contribute an important fraction of total protein intake. However, the taste difference is psychological rather than real. Meat from similar cuts, of animals of similar age, is of similar taste and few people would tell the difference. Camel meat is now available in the Abu-Dhabi market and there is a special slaughter house for camels. The meat is still the favourite meat for many people, particularly the bedouins.

The present investigation was undertaken to study in detail the gross composition, and nutritional value of the milk and meat of the Arabian camel indegenous to the United Arab Emirates.

Materials and Methods

More than 300 samples of milk were collected from as many, apparently healthy, lactating camels from Abu-Dhabi and surrounding area. Precautions were taken to prevent exposure to direct sunlight and to keep the temperature between 0 and 10^0C .

Proximate analyses were done as soon as possible and for most samples within 24 hr of collection. During collection, some relevant information regarding breed, age, lactation and number of calvings were collected.

Meat samples were collected by a food inspector and brought refrigerated to the laboratory. The samples were taken to represent different ages of camel from six months to 6 years old, and different cuts (neck, shoulder, ribs and legs).

Proximate analysis for milk was done using a Milkoscan 104 A/SN Foss Electric (Hillerod, Demark) instrument and a Mustispec (Weldrake, York, England) interfaced with a computer.

The protein for meat was determined by automatic Kjeldhal Tecator instrument, and the fat by Soxtec Tecator, Model 1043. Moisture and ash were determined using methods as described by A.O.A.C, (1984).

Fatty Acid Analysis

Fat methylated samples were determined by gas liquid chromatography. The instrument used was a Pye Unicam 304 GLC equipped with FID detector and CD 4 computing integrator.

Minerals Analysis

Ash samples of milk were analysed using Shimatzu, Model 760 Atomic Absorption Spectrophometer. The minerals for the meat were determined by Inductively Coupled Plasma (ICP) Perlain Elmer Model 400.

Results and Discussion

The most important factor in camel's milk is the water content. The highest water content was observed in summer and particularly in August which showed almost 94%. It would thus, appear that the lactating camel loses water to the milk in time of drought. The dilution of milk in times of water deprivation makes an excellent food for man.

The fat content of camel's milk varied from 1.8 to 8.3 with an average of 3.5% (Table 1). Again, the dehydration status of the animals would appear to affect the fat content of the milk, as well as the forage eaten. This level of fat is in agreement with data reported by other workers e.g. El Bahay (1962) and Sawaya et al (1984).

The protein content of camel's milk (3.0%) was lower than that of cow's milk and substantially lower than that reported for other camels. Milk collected in summer had a severely decreased protein percentage, less than 2%. Again this demonstrated the direct effect of dehydration due to hot weather on the composition of milk. It must be emphazised that the protein content of the feed will also directly affect that of the milk (Wilson, 1984).

Table 1. Physical and chemical characteristics of Fresh Camels' milk (%m/m).

Component	Minimum	Mazimum	Mean n=300	Standard Deviation
Moisture	84.10	93.30	88.48	2.19
Fat %	1.80	8.30	3.45	1.25
Protein %	1.70	6.26	3.00	0.69
Lactose %	3.38	5.90	4.17	0.82
Total Solids %	7.72	16.68	11.49	1.80
Solids Non-fat(SNF)%	5.68	10.66	11.49	1.80
Ash %	0.65	0.92	0.82	0.07
Density	1.025	1.035	1.027	0.02
Acidity (ml)	0.11	0.14	0.13	0.02
pH	6.35	6.69	6.53	0.25

The lactose content of Emirates camel's milk is 4.20% was lower than that of cow's milk. There is little variation in lactose content with season and it was found to vary between 3.40 and 5.90%.

The importance of consuming camels' milk in desert regions has been demonstrated by Cook and El Turki (1975) who found a high levels of the enzyme (lactase) when determining the intestinal lactose concentration in adult Arab in Saudi Arabia. They related this to the traditional consumption of camel's milk. This was supposed to demonstrate a selective advantage associated with the fluid and the calorific value of camels' milk and indicates the importance of camels' milk for the survival of desert nomads.

The proximate composition of camels' meat is shown in Table 2. Camel meat contains 20% protein but only about 1% fat, almost all fat being stored in the hump. This is in favour of camels' meat since the trend now is to consume meat low in fat to avoid some chronic diseases such as heart disease.

The fatty acid composition of both camels' milk and meat are shown in Tables 3 and 4 respectively. Both fatty acid profiles showed comparable values of palmitic and oleic acids, which together account for more than 50% of the total fatty acids. Therefore, it the value of camels' fat either from milk or meat is found in the moderate concentration of monoenoic acids plus linoleic acid and the polyunsaturated acids which are essential for human nutrition.

The mineral content of camels' milk and meat is shown in Table 5. It can be noted that camels' milk and meat contain adequate quantities of many essential elements. With respect to the micronutrients, the iron content (0.3 mg/100gm) of camels' milk is six time that of cows' milk (0.045mg/100gm) but the iron content of the meat is much higher (24 mg/100g).

In conclusion, camel milk and meat play an important source of nutrients for many bedouins in U.A.E as well as in many desert regions in the Arabian Gulf countries. Further studies, therefore, are needed to explore the composition of camel milk and meat. These information should be included in any food composition tables for use in the Gulf.

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Table 2. Composition of Camels meat at various ages and of different cuts, g/100g (N = 25)

Age	Portion or cut	Moisture	Protein	Fat	Ash	Energy Kcal/100g
6 months	Neck	77.46	19.01	0.99	1.19	90
OLD	Shoulder	77.10	20.09	0.96	0.11	94.4
	Ribs	78.36	19.06	1.01	0.20	90.5
	Legs	76.14	20.74	1.04	0.04	97.9
1year	Neck	76.57	18.93	0.20	0.97	84.7
Old	Shoulder	75.40	18.95	1.58	1.02	95.2
	Ribs	76.22	20.06	0.62	1.01	91.3
	Legs	76.88	19.58	0.83	1.14	91.1
	Back	75.54	18.84	1.56	0.94	94.5
2 years	Neck	74.83	20.34	0.48	1.02	91.18
Old	Shoulder	76.47	20.68	0.17	0.99	90.1
	Legs	74.35	21.96	0.13	1.07	94.9
	Back	75.45	20.36	0.22	1.04	88.9
4 years	Neck	68.83	20.57	0.29	0.99	90.5
Old	Ribs	70.32	18.15	2.23	0.93	97.61
	Legs	75.48	19.43	0.85	1.06	90.6
	Back	75.38	20.20	1.07	1.09	96.0
5 years	Neck	70.11	21.42	1.08	1.00	101.2
Old	Shoulder	75.13	20.64	0.72	1.03	94.6
	Legs	73.21	20.66	1.41	1.14	100.9
	Range	69-76	18-21	0.13-2.20	0.92-1.23	
	Average	75	20	<1.0	1.0	94.4

Table 3. Fatty Acid Composition of Camel Milk (N=75)

Fatty Acid	Range	Mean	Standard Deviation
C4:0	0.01 - 0.65	0.10	0.02
C6:0	0.10 - 0.60	0.20	0.06
C8:0	0.05 - 1.02	0.20	0.05
C10:0	0.04 - 2.66	0.20	0.03
C12:0	0.66 - 3.41	0.90	0.20
C14:0	9.27 - 13.15	11.3	1.80
C14:1	1.20 - 2.86	1.70	0.80
C15:0	0.18 - 1.99	1.30	0.40
C15;1	0.17 - 0.85	0.40	0.12
C16:0	22.62 - 29.17	28.60	2.59
C16:1	4.08 - 16.55	11.70	1.20
C17:0	0.55 - 1.35	1.10	0.09
C17:1	0.41 - 0.81	0.60	0.25
C18:0	7.00 - 14.19	10.80	1.96
C18:1	24.94 - 39.45	27.40	3.20
C18:2	1.35 - 4.06	3.10	0.86
C18:3	0.80 - 3.90	1.50	0.76
C20:0	0.06 - 0.35	0.30	0.23
C20:2	0.10 - 0.10	0.10	0.02
C22:0	0.05 - 0.10	0.10	0.01
C24:0	---- - 0.10	0.10	0.00

Table 4. Fatty Acid Composition of Camel Meat (N = 20)

Fatty Acid	Range	Mean n=20
C8:0		
C10:0		
C12:0	0.18-0.30	0.25
C14:0	4.36-644	5.46
C14:1	0.48-2.00	0.94
C15:0	0.36-1.77	0.78
C15:1	0.01-0.43	0.17
C16:0	26.50-33.06	29.12
C16:1	2.08-7.04	4.72
C17:0	0.73-1.48	1.14
C17:1	0.41-1.48	0.67
C18:0	17.32-35.78	24.18
C18:1	24.28-41.65	31.66
C18:2	-1.26	0.85
C18:3	-1.76	1.04
C20:0	-0.39	0.28
T. Saturated	58.40-69.50	61.00
T.Unsaturated	36.41-48.60	38.96

Table 5. Average mineral content of Camels' Milk and Meat (mg / 100g)

Mineral	Camels' Milk	Camels' Meat
Calcium	139	78
Copper	0.55	3.5
Iron	0.29	24
Magnesium	9	206
Manganese	0.02	0.06
Potassium	152	2631
Sodium	72	468
Zinc	0.51	39

FOOD ADDITIVES AND CONTAMINANTS IN PROCESSED FOODS CONSUMED IN U.A.E.

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Introduction

The nutritional value of raw and processed foods is essentially based on their composition, quality, presence of food additives in appropriate limits and absence of contaminants and adulterants. With limited agricultural resources, the Gulf Countries are largely dependent on imported foods. Dubai in United Arab Emirates is a focal point with about 3 million tones of food imported every year from over ninty countries world wide and about two thirds of it, re-exported to the other Gulf Countries, Middle East, Africa and CIS Countries. As food is imported from other countries, some of which lack in pre/post-harvest controls, it is essential to exercise strict quality control measures to ensure the safety and wholesomeness of foods.

Food additives and contaminants play an important role in human nutrition. Consumption of unpermitted additives and permitted additives in excessive quantities may pose long-term health effects. The interaction of some food additives with food constituents leads to the formation of interaction products and certain food additives also undergo degradation. The safety of such products needs to be established. The reduction/loss of bioavailability of some nutrients as a result of such interactions necessitates a closer look at food additives.

Modern agricultural practices, environmental pollution and global disasters result in the entry of several contaminants into our food chain. Presence of pathogenic micro-organisms, viruses, microbial toxins, enzyme inhibitors and other natural toxicants along with environmental contaminants may cause serious health risks which indirectly affects the nutritional status. The combined effect of food additives and contaminants on human health is an emerging research area. As the effects are long term, it is essential to control the use of food additives and presence of food contaminants to safe guard the health and nutritional status of consumers. This necessiates the inclusion of data on food additives and contaminants while formulating food composition tables. The Public Health Laboratory at Dubai Municipality checks several consignments of foods for their fitness and compliance with established standards following validated analytical methods. This paper details the present situation in U.A.E. with regard to food additives and contaminants. Since large quantities of food are re-exported to Gulf countries from Dubai, the data broadly represents the situation in the Gulf region. An attempt has been made to correlate interactions of food additives and constituents and their effect on the nutritional value of foods.

Role of Food Additives in Processed Foods

Food additives play an important role in processed foods. At present, over 4000 chemical compounds are approved for food applications and maximum limits are established for about 500 compounds in different categories of foods. They are classified into 23 classes depending on their role in foods such as food colours, preservatives, anti-oxidants, non-nutritive sweeteners, emulsifiers, stabilizers, thickening agents, acids, bases, salts, bleaching, maturing agents and flour modifiers, anti-caking and dusting agents etc. The FAO/WHO Joint Expert Committee on Food Additives (JECFA) evaluates food additives, based on the toxicological data available from time to time, and allocates acceptable daily intake (ADI). Based on technological requirements, consumption rate and ADI, member countries establish their maximum limits in different foods.

Food Colours

Food colours play an important role in the palatability and aesthetic appeal of foods. They are added to restore natural colour of the commodity lost during processing or storage but not to mask any inferiority in the product (King, 1980). Food colours are classified into a) Natural and b) Synthetic colours. Natural colours have low tinctorial value, low solubility in water and less stability which poses problem for their application. However, they have been found to be safe for consumption. On the other hand, synthetic colours possess high tintorial power, high water solubility and stability which make them more suitable for food applications. The purity of synthetic colours plays an important role as several intermediate compounds with varying toxicities as well as metallic contaminants may be present in commercial coal-tar colours. Food Additives and Contaminants Committee (1979) in their report believes that the specifications of food colours are far from satisfactory with regard to the content of subsidiary dyes, starting materials, intermediates and other contaminants. Thirteen synthetic food colours are permitted in U.A.E. (Table 1).

Use of un-permitted colours such as metanil yellow, rhodamine B amaranth, patent blue V, green S and some textile dyes in confections, pickled vegetables, sugar coated nuts and soft drinks is a major problem. A total number of 3624 samples were analysed for the detection of unpermitted colours and 117 samples amounting to 3.22% were found to contain unpermitted colours (Table 2). The poor quality of tomato paste, ketchup and high value products such as saffron is often masked by addition of synthetic colours. Among 380 samples analysed for colours, where their addition is not allowed, 24 samples (6.32%) were found to contain colours (Table 3). Regular consumption of excess quantities of colours has been found to cause some allergic reactions and may cause long-term health problems. Base-line data on quantity of permitted colours indicate that snack foods and confections contain excessive quantities (Table 4) and 9.56% of samples exceeded the maximum limit of 200 ppm of total dye content set by E.E.C.(E.C. Directive, 1994). As these products are consumed mostly by children, it is essential to amend the existing U.A.E. standards on colouring matter in foods by incorporating maximum limits in different categories of foods.

Food Preservatives

Microbial spoilage of foods is a major problem in extending shelf-life of processed foods such as fruit juices, soft drinks and concentrates, jam, jelly, marmalade, ketchups, sauces, pickles, cheeses and some meat products. Preservatives are classified into two groups Class I and Class II. Class I preservatives are generally regarded as safe (GRAS) and no maximum limits are set for their use in different foods. Class II preservatives such as benzoic acid, sorbic acid, propionic acid, p-hyroxy benzoic acid esters, sulphur dioxide, nitrite, nitrate, nisin etc. are mainly used in processed foods. It is essential to control the addition of preservative in different foods as the total dietary intake of a single compound from different foods may exceed ADI and long term consumption is undesirable.

Quality control analysis of fruit and vegetable products for benzoic acid indicate that 1.48% samples (Table 5) exceeded maximum limits where as all samples analysed for sorbic acid and sulphur dioxide have been found to be satisfactory (Table 6).

Non-Nutritive Sweeteners

Non-nutritive sweeteners are intense sweet tasting substances with less than 2% calorific value of sucrose per equivalent weight of the compound. They include saccharin, aspartame, acesulfame, dulcin, cyclamate, talin, neohesperidin, stevioside etc. These additives are used in low calorie, dietetic foods and as table top sweeteners. In U.A.E., saccharin and aspartame are permitted for food applications.

Analytical data (Table 7) on non-nutritive sweeteners at Public Health Laboratory indicate both aspartame and sacchain are within limits, except in one sample of betelnut preparation (supari) that contained saccharin which is not permitted. Ten samples were found to contain acesulfame-K, not permitted in U.A.E. at present. All samples of diet drinks analysed for saccharin and aspartame were found to be satisfactory.

Antioxidants

Rancidity is a major problem in fats and fatty foods causing off flavours. Antioxidants interfere with the free radical mechanism and terminates the chain reaction. Antioxidants are of 2 types, natural (tocopherols, ascorbic acid, citric acid etc.) and synthetic (Gallates, BHA, BHT, TBHQ, NDGA, ethoxyquin, Ionox-100 etc.). Among synthetic anti-oxidants, gallates, BHA and BHT are permitted in U.A.E. Base-line data on 172 samples of oils and fats and snack foods indicate permitted anti-oxidants are well within limits (Table 8). Ten samples were found to contain TBHQ, at present not permitted in U.A.E.

Miscellaneous additives

Food additives such as caffeine, quinine are added to cola drinks, tonic waters etc. as astringents. Analytical data on caffeine and quinine indicate that they are within limits in all cola based drinks and tonic waters. Flavours such as vanillin and ethyl vanillin are

used in may foods and these additives need to be controlled as excess consumption may lead to long term health risks. Flavour enhancers such as monosodium glutamate and sodium inosiate are used in snack foods, meat, soups, sauces etc. It is essential to control their addition, as excessive consumption of glutamates has been reported to cause brain damage in infants and paralysis of lower limbs known as 'Chinese syndrome. Since, glutamic acid is a naturally present amino acid, a maximum limit of total glutamic acid in snack foods may be proposed. Anticaking agent, potassium ferrocyanide (15 ppm max. limit in edible salt) and anti-foaming agent, polysiloxilane cause adverse health effects when consumed in large quantities.

Food Contaminants

Food contaminants can be classified into a) Environmental contaminants (heavy metals, pesticide residues, radionuclides, polyaromatic hydrocarbons (PAHS), polychlorinated biphenyls (PCBs), dioxins etc., b) Microbial contaminants (pathogenic bacteria, viruses, mycotoxins and other microbial toxins), c) Veterinary drug residues (antibiotics, anthelmentic, antiseptics etc. and growth hormones), d) Migration of packaging materials into foods and e) Natural toxicants (enzyme inhibitors, alkaloids and other poisonous compounds). Environmental pollution (air, water and soil), global disasters, mining and use of modern agricultural practices result in the release of these contaminants into our environment which end up in our food chain through various routes of entry. Food contaminants do not play any role in the life processes of humans and are highly toxic in nature and some have been found to be carcinogenic. Long term intake of such compounds may lead to serious health hazards.

Heavy Metal Contaminants

Heavy metals refer to the unwanted presence of certain elements which might have come into our food inadvertantly before, during or after processing of food. Heavy metals such as lead, cadmium, arsenic, mercury are released into the environment through industrial activities, mining dumping of toxic waste and it is possible for it to enter the food chain. Use of heavy metal compounds such as lead arsenate, arsanillic acid, organomercury compounds as fungicides and seed dressings also lead to their entry into the environment. Lead may directly entry into the canned foods leaching from solderings. Due to their high affinity towards plant and biological tissues, they get accumulated in plants and certain organs of animals including fish and other aquatic animals.

JECFA evaluates the safety of heavy metals based on the available toxicological data from time to time and allocate maximum tolerance limits. The toxicological data on heavy metals has been summarised in a series of technical reports published by WHO (1990). The effects of heavy metal poisoning include anaemia, convulsions, kidney and liver damage, loss of memory, loss of hair and certain skin lesions.

Base-line data on heavy metal contarninants in high risk foods in U.A.E. indicate significantly low contamination. A total number of 1016 samples of meat, fish and their products, spices, canned foods, infant and dairy products were analysed for their metals

and 11 samples were found to exceed maximum limits (Table 9). However, as food is imported from different geographical regions, it is essential to conduct regular surveys to form a data-base, to assess the dietary intake levels as well as to identify high risk foods and zones (countries).

Mycotoxins

Mycotoxins are highly toxic secondary metabolites products by certain moulds. Several mycotoxins namely aflatoxins (B1, B2, G1, M1, M2), ochratoxins, zeralenone, tricothecenes, patulin, citrinin and ergot alkaloids produced by different strains. Feeding of contaminated fodder results in the injection of aflatoxins into cattle which are transformed into M1 and M2 and are partly excreted in milk.

The toxicity of mycotoxins is complex and species specific. Some species of animals such as chickens, turkeys and rabbits are extremely sensitive with acute toxicity of B1 with low LD 50 values (FAO, 1993). The target organ is usually the liver which leads to either detoxification or chronic toxicity resulting in carcinogenicity. Epidomiological studies have suggested that aflatoxins are acute poisons and carcinogens.

Appropriate temperature and water activity are congenial for the growth and proliferation of aflatoxin producing moulds in peanuts, pistachios, maize, corn parboiled rice and dried figs. Heterogenecity in the distribution of aflatoxins is the main factor affecting the analytical results. Sampling and preparation of test sample play an important role in assessing the exact level of toxins in foods. Analytical data on aflatoxins at Public Health Laboratory indicate high aflatoxins levels in peanut, peanut products and pistachios (Table 10). About 30% samples were found contaminated with aflatoxins and 13.9% samples were found containing high level of toxins ranging from 24.6 - 1108 ppb. Pistachios from Iran, in particular, the 1995 crop has been highly affected resulting in very high level of aflatoxins. Peanuts and peanut products from India and China are again the high risk commodities. It is essential to monitor the levels of ochratoxins, zeralenone and patulin to safeguard the health of consumers.

Radionuclides

Radionuclides enter into our food chain from nuclear accidents, testing of atomic weapons and dumping of nuclear waste. The gamma emitters, which are highly energetic, cause cell damage and produce radiotoxicity in humans. The most significant long-lived contaminants arising as a result of radioactive fallout are Cs-134, Cs-137 and Sr-90. Radionuclides in foods are regularly monitored at Public Health Laboratory. During the past six years, a total of 20714 food samples were screened for radionuclides and 29 samples (Two milk powders, 20 pasta products, 7 thyme and one tea sample) were found to contain high total cesium activity (Table 11). The ratio of Cs-137 to Cs-134 around 11 in contaminated samples indicate a probability that the source of contamination might be from Chernobly accident debris. However, the gradual fall in cesium levels in different foods 20 - 50 Bq/kg in 1990 to the present levels of 5-10Bq/kg indicate reduction in contamination.

Pesticide Residues

Pesticide residues enter our food chain as a result of modern agricultural practices and Gulf countries are in a more complex situation, importing foods from all over the globe. Apart from local production in U.A.E., over 40 containers of various fruits and vegetables are imported into Dubai alone every day from over 15 countries. Some countries lacking controls either use banned pesticides or permitted ones in high amounts leading to hig residue levels. The commodity/pesticide combinations differ in different countries and lack of such data make the situation more complex. The evaluation of pesticide residues in foods started in 1963 by WHO in colloboration with FAO. Since then, Joint Meeting on Pesticide Residues (JMPR) has evaluated a large number of compounds and allocated maxium residue (MRLs) which are revised from time to time (FAO, 1993).

The Public Health Laboratory has validated the multi-residue methods for the determination of organochlorine, organophosphorous and carbamate pesticides in fruits & vegetables, fatty foods and cereals and their products. Preliminary monitoring data on pesticides (Table 12) show the level of residues of total DDT, endosulfan, lindane, chlorpyrifos, fenitrothion, acephate, carbaryl and propoxur.

Daminzide (alar), a plant growth regulator, is used particulary for apples and pears to prevent pre-harvest drop of fruit and to control extension growth in young trees. Unsymmetrical dimethyl hydrazine (UMDH), a degradation product of daminozide has been found to be carcinogenic (NCR, 1978). EPA drafted a proposal to phase out the use of alar. Analytical data on daminozide residues show that about 49% apples contained residues in the range of 0.02 - 1.94 ppm.

Veterinary Drugs and Growth Hormones

The use of veterinary drugs such as antibiotics, antiseptics, anthelmentics and growth hormones in the animal husbandary is on the increase. Their residues in dairy products and meat may pose problems as consumers may develop resistance for certain drugs. JECFA has evaluated several veterinary drugs and recommended maximum residue levels (King, 1980). Synthetic hormones such as zeranol, trenbolone are presently in use. Stilbenes were withdrawn in 1978. JECFA has evaluated zeranol and trenbolone and allocated 0.50 and 0.02 ug/kg b.w. respectively with maxium residues levels of 2.0 and 10 ug/kg in muscle and liver respectively for both compounds. The reports of FDA, USDA and E.E.C. indicate the residue levels are almost nil to minimal. However, it is essential to monitor the residue levels of veterinary drugs to avoid long-term problems. Public Health Laboratory is standardising and validating analytical methods.

Migration of Packaging Materials

The use of plastics, polyethylene, polyvinyl chloride, polystyrene, polypropylene, nylon and ionomer polymers as fills, laminates, rigid and semi-rigid containers for packaging foods and pharmaceuticals is on the increase. Although, plastics are generally inert, the chemicals used as processing aids, residual monomers, catalyst remnants etc. may leach

into the foods during direct contact with the food. E.E.C has proposed a maximum advisory limit of 10 mg/dm^2 (Food Additives and Contaminants Committee, 1979). Surveys conducted for plasticizer migration components such as di-(2-ehytlhexyl) adipate (DEHP), di-(2-ehtylhexyl) phthalate (DEHP) and diisooctyl phthalate (DIOP) in foods, in particular, fatty foods, indicate samples in contact with PVC films were found to contain detectable amounts of DEHA and about 40% of samples exceeding 30 ppm (Kozyrod etal, 1989; Kondyli etal, 1992; Piringer, 1994). Vinyl chloride monomer (VCM) in PVC containers had been a problem earlier. However, with development of advanced manufacture processes of PVC, the monomer is almost eliminated. As foods are imported from different countries and at times subjected to adverse temperature conditions, it is essential to monitor the residues of plasticizers in foods.

Pathogenic Microorganisms and Toxins

The presence of pathogenic microorganisms such as Salmonella, Shigella, Listeria monocytogenes, Yersinia enterocolitica, Campylobacter spp., Clostridium perfringens and toxin producing microbes such as Staphylococcus aureus, Bacillus cereus and Enterotoxigenic E. coli in foods can lead to foodborne illness. The common symptoms include diarrhoea, vomiting, abdominal pain and other gastrointestinal disorders. Other complications include meningitis, abortions in pregnant women, septicemia etc. Surveys conducted at the Public Health Laboratory indicate presence of Listeria in about 8% of samples (Table 14). Yersinia in about 6% of samples (Table 15), Campylobacter, Aeromonas hydrophila and verotoxigenic E. coli need to be collected to formulate standard. The bacterial toxins such as staphylococcal and B. cereus toxins need regular monitoring in high risk foods. The other natural toxins such as ergot alkaloids, shell fish toxins namely BSP and DSP toxins and enzyme inhibitors need monitoring as these compounds along with pathogens may cause serious foodborne illnesses which indirectly affect the nutritional status.

Other Environmental Contaminants

Environmental contaminants such as PAHs, PCBs, and dioxins are equally important in human health. Disasters such as oil spills can cause serious environmental problems to aquatic animal sand birds. High concentration of PAH levels were found tinned fish and mussels from Alaska. The tar acids are toxic and can cause serious health hazards. Monitoring of these contaminants in aquatic foods well as drinking water is essential to provide maximum consumer safety.

Interaction of Food Additives

The chemistry of interactions between food additives and constituents is a complex field. Food additives such as food colours, preservatives etc. interact with food constituents and some intraction products have been isolated in model systems. Food additives such as preservatives, antioxidants and non-nutritive sweeteners also undergo degradation and some degradation products also have been isolated. Some food additives along with food constituents also influence the bioavailability of certain trace elements. The safety of some interaction and degradation products needs to be established. Food preservatives exert their action through specific interactions with components. Sulphurdioxide combines with unsaturated intermediates formed in the

non-enzymatic browning reactions of reducing sugars as well as ascorbic acid. Some sulphonated polymers are formed with coloured browning products. The dienoic structure of sorbic acid makes it susceptible to nucleophillic attack at the fifth carbon. Nitrites react with aminoacids to produce volatile and non-volaltile N-nitrose derivatives (nitrosamines) which are toxic. Food colours, the sulphonicacid dyes have been found to react with amino acids and proteins producing complex interaction compounds (Marimon, 1984).

Phenolic antioxidants undergo degradation and several degradation products have been reported (FAO/WHO, 1980). Aspartame, has been found to degrade to diketopiperazine (DKP), a sweetless compound for which an ADI of 0-7.5 mg/kg has been assigned [22]. slight degradation of acesulfame was also reported in acidic products with pH less than 3.0.

The influence of proteins, organic acids and polyphenols on the bioavailability of trace elements, especially iron and zinc has been well documented (Farre et al, 1992). The effect of Millard reaction products on the availability of zinc has also been studied (Fairweather e al 1989).

The toxicity of complex interaction products and some degradation products of food additives need to be established. These products may pose some health problems which indirectly affect nutritional status.

Conclusion

The laboratory data on food colours indicate some unpermitted colors are still in use and the quantity of colours particularly in snack foods, which are consumed largely by children, is very high. Excess quantities of benzoic acid was also found in some imported products. Anti-oxidants, non-nutritive sweeteners and other additives are within limits. The heavy metal contaminants are mostly within acceptable ranges, but mycotoxin levels, particularly in some peanuts and pistachios are very high. The radionuclide levels in foods are on the decrease over the years. Preliminary data on pesticide residues indicate presence of residues mostly within limits. However, more data is required to reach a conclusion. The presence of certain pathogens in some high risk and priority foods is again a concern, although food poisoning cases in U. A. E. are relatively low even when compared to those in developed countries.

The total daily intake of an additive from different foods may exceed its recommended ADI. However, additional data on certain additives and contaminants is required to assess their dietary intake levels. The combined effect of additives & contaminants along with their interaction/degradation products on human health and nutritional status is a complex field and difficult to establish. Literature on interaction studies among different ethnic groups with varied food habits differs to some extent and is difficult to establish.

Recommendations

It is strongly recommended that the data on food additives and contaminants include

metal and radionuclides (contamination levels are far below the existing limits) for maximum consumer safety. It is recommended to form expert committees on food additives and contaminants both at national and regional levels, to study the status of food additives and contaminants and recommend maximum levels. Necessary infrastructure and facilities should be provided to laboratories to produce reliable data for making food composition tables. Some laboratories having facilities and expertise may be selected as principal laboratories to validate analytical methods, provide training, conduct inter-laboratory collaborative studies, exchange of information and to process the data for making composition tables.

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Table 1 : List of Permitted Synthetic Food Colours In The U.A.E.

E. NO.	DESCRIPTION	C.I. NUMBER	ADI (mg/kg b.w.)
E 102	Tartrazine (Yellow No. 5)	19140	0 -- 7.5
E 104	Quinoline Yellow (Yellow No. 1)	47005	0 -- 0.5
E 110	Sunset Yellow FCF (Yellow No. 6)	15985	0 -- 2.5
E 122	Azorubine (Carmoisine)	14720	0 -- 4
E 124	Ponceau 4R (Red 2)	16255	0 -- 4
E 127	Erythrosine (Red 3)	45430	0 -- 2.5
E 128	Red 2G	18050	0 -- 0.1
E 129	Allura Red	16035	0 -- 7
E 132	Indigo Carmine (Indigotine) (Blue No.2)	73015	0 -- 5
E 133	Brilliant Blue FCF (Blue No. 1)	42090	0 -- 12.5
---	Fast Green FCF (Green No. 3)	42053	0 -- 12.5
E 151	Brilliant Black PN (Black No. 1)	28440	0 --1.0
E 155	Chocolate Brown HT (Brown No. 3)	20285	0 -- 15.0

Table 2 : Detection of Unpermitted Colours in Foods

S. No.	Description	No. of Samples Analyzed	No. of Unfit Samples	% Unfit Samples	Remarks
1	Hard-boiled Confections, Coated Nuts, Chocolates, Chewing Gum & Misc. Sweets	1064	46	4.32	Amaranth, Patent Blue V, Green S, textile dyes
2	Pickled Vegetables	105	55	52.4	Textile dyes
3	Snack Foods (Crisps, Chips, Cheese balls biscuits)	536	5	1.14	Amaranth, Unidentified Colours
4	Soft Drinks, Squash & Syrups	862	6	0.70	Green S, Amaranth Patent Blue V
5	Miscellaneous Foods	1067	5	0.51	Amaranth Green S
	Total	3634	117	3.22	

Table 3 : Detection of Permitted Colours in Foods Where Addition of Colours is not Allowed

S. No.	Description	No. of Samples Analyzed	No. of Unfit Samples	% Unfit Samples	Remarks
1	Tomato Ketchup & Sauce	214	6	2.80	Tartrazine, Ponceau 4R
2	Tomato Paste	142	12	8.45	Ponceau 4R, Erythrosine
3	Saffron	24	6	25.0	Sunset Yellow, Tartrazine Ponceau 4R, Carmoisine
	Total	380	24	6.32	

Table 4 : Quantity of Added Colours in Foods in U.A.E.

S. No.	Description	No. of Samples Analyzed	No. of Unfit Samples	% Unfit Samples	Total Dye Content in Unfit Samples (Range in ppm)	Remarks
1	Snack Foods (Cheese balls, Pofaki Curls, Crisps)	49	12	24.5	210 -- 1336	Tartrazine and Sunset Yellow found and Quantity exceeds 200 ppm
2	Soft Drinks	56	---	0.0	----	Permitted colours found Quantity is less than 200 ppm
3	Concentrates (Syrups, Squash)	8	---	0.0	----	Permitted colours found Quantity is less than 200 ppm
4	Sweets & Confections	54	4	7.41	236 -- 428	Permitted colours found Quantity exceeds 200 ppm
	Total	167	16	9.56		

Table 5 : Status of Benzoic Acid in Processed Foods in U.A.E.

S. No.	Description	No. of Samples Analyzed	No. of Unfit Samples	% Unfit Samples	Range (ppm) in Unfit Samples	Remarks
1	Soft Drinks	231	7	3.03	226 -- 245	> 150 ppm limit
2	Fruit Juices and Drinks	861	3	0.35	185 -- 230	> 150 ppm limit
3	Squash, Syrup and Concentrates	117	3	2.56	733 -- 808	> 150 ppm limit on dilution
4	Ketchups and Sauces	285	9	3.16	387 -- 872	> 250 ppm limit in Ketchup > 500 ppm in Sauces
5	Miscellaneous Foods (Pickles, etc.)	126	2	1.59	542 -- 1018	> 500 ppm limit
	Total	1620	24	1.48		

Table 6 : Status of Sorbic Acid and Sulphur Dioxide in Foods in U.A.E.

S. No.	Description	Sorbic Acid		Sulphur Dioxide	
		No. of Samples Analyzed	Range (ppm)	No. of Samples Analyzed	Range (ppm)
1	Carbonated Soft Drinks	58	46.8 - 178	---	---
2	Fruit Juices, Drinks	67	24.5 - 202	54	21.8 - 55.7
3	Squash, Syrup & Concentrates	32	84.6 - 532	32	40.5 - 242
4	Jams, Jellies and Marmalade	12	78.0 - 164	28	124
5	Dried Fruits	16	546 - 1246	18	342 - 1028
6	Cheeses	20	524 - 1846	---	---
	Total	205		136	

No. Of Unfit Samples = Nil

Table 7 : Status of Non-nutritive Sweeteners in Foods in U.A.E.

S. No.	Description	No. of Samples Analyzed	No. of Unfit Samples	% Unfit Samples	Range of Sweeteners (ppm) " Max. Limit"			Remarks
					Saccharin	Aspartame	Acesulfame--K	
1	Soft Drinks (Carbonated)	44	0	0	82 -- 100	256 -- 542	----	Sweeteners permitted and within max. limits
2	Fruit Drinks / Concentrates	31	8	25.8	58 -- 92	312 -- 468	158 -- 242	Acesulfame present in 8 samples -- not permitted
3	Chewing Gum & Bubble Gum	18	0	0	----	126.5 -- 582	----	Satisfactory
4	Tabletop Sweetener Sachets	7	2	28.6	----	0.06 -- 1.0%	0.24%	Acesulfame in 2 samples - not permitted
5	Supari	4	1	25	2007	----	----	Saccharin present -- not permitted
	Total	104	11	10.6				

Table 8 : Status of Anti-oxidants in Foods in U.A.E.

S. No.	Food Items	No. of Samples Analyzed	No. of Unfit Samples	% Unfit Samples	Range (ppm)			Remarks
					Gallates "100"	BHA "200"	BHT "200"	
1	Oils & Fats	126	4	3.17	----	56 -- 156	48 -- 76	TBHQ present in 4 samples
2	Snack Foods	46	6	13.0	24	32 -- 77	36 -- 49	TBHQ present in 6 samples
	Total	172	10	5.81				

Table 9 : Assessment of Heavy Metal Contaminants in Foods in U.A.E.

S. No.	Food Item	No. of Samples Analyzed	No. of Unfit Samples	% Unfit Samples	Range of Heavy Metals (ppm)				Remarks
					Pb	Cd	As	Hg	
1	Fish (Local) (Fresh / Chilled)	146	3	1.37	0.02 -- 0.86	0.01 -- 0.06	0.02 -- 0.24	0.02 -- 0.86	Mercury in 2 samples >0.5 ppm
2	Fish & Fish Products Imported (Frozen & Canned)	97	2	3.09	0.08 -- 2.09	0.02 -- 0.52	0.02 -- 0.56	0.02 -- 1.58	Mercury in 3 samples >0.5 ppm,lead in a caviar sample >2.0 ppm
3	Meat & Meat Products (Fresh / Frozen & Canned)	32	0	0	0.16 -- 0.77	0.02 -- 0.28	0.02 -- 0.28	0.00 -- 0.05	Lead in 8 samples >0.5 ppm but within max. limit
4	Spices & Spice Powders	88	6	6.82	0.03 -- 2.37	0.02 -- 0.18	0.02 -- 0.42	----	Lead in 2 turmeric powder samples, 1 cumin powder and mixed spices >2.0 ppm
5	Canned Fruit & Vegetables	84	0	0	0.02 -- 0.38	0.02 -- 0.08	0.02 -- 0.16	----	All samples within maximum limits
6	Infant Foods	118	0	0	0.00 -- 0.08	0.00 -- 0.05	<0.02	<0.005	All samples within maximum limits
7	Dairy Products	55	0	0	0.02 -- 0.70	< 0.02	<0.02	<0.01	All samples within maximum limits
8	Water & Mineral Water	396	0	0	0.00 -- 0.02	0.00 -- 0.01	0.00 -- 0.02	0.00 -- 0.004	All samples within maximum limits
	Total	1016	11	1.08	0.00-- 2.37	0.00-- 0.52	0.00-- 0.56	0.00-- 1.58	

Table 10 : Assessment of Aflatoxin Levels in Foods in U.A.E.

S. No.	Food Item	No. of Samples Analyzed	No. of Positive Samples	% Positive Samples	No. of Unfit Samples	% Unfit Samples	Range of Toxins in Unfit Samples	Remarks
1	Peanuts	127	55	43.3	17	13.4	48.6 -- 897	High level (>500 ppb) in 4 samples -- High B_1 & B_2
2	Peanut Butter	26	8	30.8	0	0	----	Satisfactory
3	Peanut Candy, Balls & Chocolate	65	31	47.7	20	30.8	24.6 -- 1108	High level (>500 ppb) in 6 samples -- High B_1 & B_2 -- High G_1 & G_2 in 1 sample
4	Pistachio Nuts	118	48	40.7	29	24.6	28.0 -- 649	-- High B_1 & B_2
5	Maize	18	1	5.55	0	0	---	Satisfactory
6	Parboiled Rice	12	0	0	0	0	---	Satisfactory
7	Dried Figs & Apricots	16	2	12.5	0	0	---	Satisfactory
8	Almonds and Cashew Nuts	35	0	0	0	0	---	Satisfactory
9	Desiccated Coconut	38	0	0	0	0	---	Satisfactory
10	Milk & Milk Products	19	0	0	0	0	---	Satisfactory
	Total	474	145	30.6	66	13.9	24.6 -- 1108	

Table 11 : Assessment of Radionuclides in Foods of U.A.E.

S. No.	Food Item	No. of Samples Analyzed	No. of Unfit Samples	% Unfit Samples	Cesium Activity (Range,Bq/kg) Cs -134	Cs-137	Remarks
1	Dairy Products	4156	1	0.02	21.2	242.6	Total Activity exceeding 240 Bq/kg
2	Infant Foods	1021	0	0	---	---	Satisfactory
3	Cereals, Pulses & Semolina	1846	0	0	---	---	Satisfactory
4	Pasta Products	2950	20	0.68	14.3 -- 29.7	68.2 -- 146.8	Total Activity exceeding 75 Bq/kg
5	Spices & Condiments	1456	0	0	---	---	Satisfactory
6	Meat, Fish & their Products	1706	0	0	---	---	Satisfactory
7	Plantation Products	863	8	0.93	21.4 -- 56.5	148.6 -- 331.0	Satisfactory
8	Miscellaneous Products	6716	0	0	---	---	Total Activity exceeding 75 Bq/kg
	Total	20714	29	0.14			

Table 12 : Assessment of Pesticide Residues in Foods of U.A.E.

S. No.	Food Item	No. of Samples Analyzed	No. of Positive Samples	Organochlorine		Organophosphorous		Carbamate	
				Name	Range	Name	Range	Name	Range
1	Vegetables	25	14	Endo-sulfan	0.10 --0.57	Chlor-pyrifos Dime-thoate	0.02-- 0.41 0.01-- 0.05	Pro-poxur Car-baryl	0.14 0.65
2	Fruits	16	3	---	---	Ace-phate	0.02	---	---
3	Cereals & Flour	6	2	DDT	0.15	Feni-trothion	5.62	---	---
4	Meat & Meat Products (Fat Basis)	9	3	DDT Lindane	0.02-- 0.34 0.02-- 0.05	---	---	---	---
	Total	56	22						

Table 13 : Daminozide (Alar) Residues in Fruits and Fruit Products

S. No.	Description	No. of Samples Analyzed	No. of Positive Samples	% Positive Samples	
1	Apples	37	18	48.6	0.02 -- 1.94
2	Plums	13	1	7.69	0.35
3	Grapes	4	0	0	---
4	Other Fruits	7	0	0	---
5	Tomatoes	5	0	0	---
6	Apple Juice	11	4	36.4	0.02 -- 0.10
7	Grape Juice	2	0	0	---
8	Baby Foods containing apple as ingredient	7	0	0	---
	Total	86	23	26.7	

Table 14 : Survey for the Presence of Listeria Species in Different Foods In U.A.E.

Food Category	Imported Foods			Local Foods		
	Samples Analysed	Positive Samples	% Positive Samples	Samples Analysed	Positive Samples	% Positive Samples
Fresh Meat	56	7	12.5	14	--	--
Fish	--	--	--	44	2	4.55
Fresh Chicken	--	--	--	30	10	33.3
Frozen Chicken	39	32	82.1	--	--	--
Vegetables	99	2	2.02	84	2	2.38
Semi-processed Meat Products	--	--	--	107	34	31.8
Milk	--	--	--	182	--	--
Cheese	196	4	2.04	53	--	--
Ready-to-eat Foods	--	--	--	107	--	--
Traditional Foods	--	--	--	90	--	--
Total	390	45	11.5	711	48	6.75

Table 15: Status of Yersinia enterocolitica in Foods in U.A.E.

FOOD TYPE	NO. OF SAMPLES	NO. OF POSITIVE SAMPLES	% POSITIVE SAMPLES
Pasteurised Milk	160	1	0.6
Raw Milk	75	0	0
Meat & Burgers	126	25	20
Cold Salads	134	4	2.9
Sea Foods	73	3	4.1
Chicken	434	36	8.3
Water	30	1	5.0
Ready To Eat Foods	75	0	0
Cheese	15	1	6.6
TOTAL	1122	71	6.33

TABLE 16 : Status of Campylobacter species and Salmonella in Foods in U.A.E.

Type of Sample	Campylobacter			Salmonella		
	No. Of Samples	No. of Positive Samples	% Positive Samples	No. Of Samples	No. of Positive Samples	% Positive Samples
Chicken (Local, Chilled)	58	3	5.20	42	29	69.0
Chicken (Imported, Frozen)	50	0	0	50	21	42.0
Chicken Liver (Chilled)	16	0	0	16	14	87.5
Chilled Meat, Imported	5	0	0	5	3	60.0
Frozen Meat, Imported	6	0	0	6	2	33.3
Beef Burger, Frozen	6	0	0	6	0	0
Chicken Burger, Frozen	6	0	0	6	0	0
Ready-to-eat Foods (Meat-based)	35	0	0	35	0	0
TOTAL	182	3	1.60	166	69	41.6

COMPOSITION OF SOME EDIBLE BIVALVES FROM BAHRAIN

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Introduction

Bahrain is an archipelago of 33 islands surrounded by shallow water mostly colonized by coral reef and sea grass. The Arabian Gulf, including Bahrain, harbors characteristically abundant marine resources, and Bahraini people have a strong adherence to the sea. Fishing has been an important vocation of the local people and seafood has been a staple item and a good source of protein in the Bahraini diet. Fish consumption is fairly high, 17 kg/yr per capita, compared to other Arab countries. Such demand for seafood exerted great pressure on the dwindling fishery resources. The government imports fish in order to meet the demand on it. In this connection, exploitation of other marine resources such as clams, oysters and gastropods becomes imperative to supplement the protein diet.

At present the majority of information on nutritional values of fish consumed in the Arabian Gulf region is based upon commercially important fishes such as the Spanish mackerel, groupers, rabbit fish and mullets (Das et. al., 1976; Kamel et al., 1979, 1980; and Al-Judaimi, et al, 1981). There is insufficient data on the composition of some important edible marine molluscs from Bahrain for use by consumers and dieticians. The present work is the first in a series of investigations to evaluate the composition and nutritional value of some potentially edible marine molluscs from Bahrain. Traditionally, several molluscan species are consumed, namely the cuttle fish, pearl oysters, two species of snails, and three species of clams.

Materials and Methods

The study was based on fresh clam samples obtained from the intertidal mud flats at Tubli Bay on three sampling occasions from 28 March to 30 April 1995. The clams were collected by raking the bottom sediment to a depth of about 10 cm during low tide. For each collected clam species, the common marketable sizes were selected. Following the collection, the calms were transported live to the laboratory and maintained in ambient filtered seawater for a maximum of 24 hours to allow gut clearance. Morphometric measurements such as shell length, shell width and shell height were recorded for each clam species collected. Eight to ten individuals of each clam species were selected on each sampling data. The soft tissue was removed, weighed and left in an oven for three days at 70^{O}c to dry to a constant weight and then reweighed. The dried tissue was then crushed to powder. For each biochemical constituent the dried powder was used and all measurements were taken in duplicate. The method of Lowery et al. (1950), Dubois et al. (1956), Bligh & Dyer (1959) and Postma & Stroes (1968)

were employed, with some modification, to determine protein, carbohydrate and total lipid levels, respectively. The biochemical results were expressed in mg per mg dry tissue weight.

Results and Discussion

The proximate composition has been widely used as a general assessment of food composition. Nutritional data on fishes of commercial importance from various parts of the world is exhaustive (Love, 1970; Bonnet, et al., 1974; Sidwell, et al., 1978). Kamel and Allam, (1979, 1980) and , more recently, Al-Judaimi, et al., (1981) analysed some Gulf fishes. However, information on the nutritive value of shellfish, oysters and clams, specifically from the Gulf area, has not been investigated. The present study is the first in the series of research designed to investigate the biochemical composition and nutritional value of potentially edible marine invertebrates which are abundant in the intertribal areas around Bahrain.

A total of 90 samples representing three different clams, mainly *Marcia flamea*, *Protapes sp.* and *Circenita callipyga* were analysed for biochemical compounds such as proteins, carbohydrates, total lipids and cholesterol levels in addition to the monitoring of flesh wet and dry weights. The overall average values of the biochemical compounds were determined for the whole soft flesh and no attempts were made to analyze separate body parts. Differences in each biochemical constituents were found among the clam species. Such interspecies variations were statistically analyzed (*ONE WAY AVOVA*) and the mean levels were compared using Duncan's test, (Table 1). Pairwise comparison of biochemical compounds between species indicated that *Circanita callipyga* exhibited significantly higher protein (0.229) and lower cholesterol (0.0033) than those found in *Protopes sp.* and *Marcia flamea*, respectively (fig. 1a, d). *Marcia flamea*, on the other hand, was extremely rich in carbohydrates (0.2220) and specifically in cholesterol (0.0059), despite smaller body size and weight, compared to the other two species. In this connection, *protapes sp.* exhibited moderate concentrations of protein and carbohydrates irrespective of larger body size and weight. However, total lipids of this species were significantly lower than the other clams. In general, these pairwise comparisons among species indicated the relative importance of each biochemical component in relation to spawning activities in each species. Although sampling was short, a temporal variation in biochemical compounds was found, protein levels in *Circenita callipyga* was consistently higher than those found in the other two clams, with the exception of the second sampling occasion where no significant variation among species was observed. Exceptionally higher protein levels were recorded in March, 0.3078 mg/mg dry weight in *Circenita callipyga*, but a drop to 0.1638 mg/mg dry weight was observed in mid-April followed by a rapid increase at the end of April, 10.2409. The sudden significant decrease in protein levels in mid-April suggested the utilization of protein for spawning activity.

Similarly, in *Marcia flamea*, although significant fluctuation ($P<0.05$) occurred in all biochemical constituents throughout the sampling period, these were less marked than in total lipids. In this species, total lipids were an initially high 6% but gradually decreased to 4.2% in mid-April and then subsequently increased to 5.3% at the end of April.

Such fluctuating patterns reflected that each clam species mobilized different biochemical compounds during gametogensis.

The present study clearly demonstrated that some intertidal clams, *Circenita callipyga*, are fairly high in protein and extremely low in cholesterol but appreciably higher in total lipids compared to *Marcia flamea* and *Protapes sp.* Additional data are needed on seasonal changes in biochemical compounds in order to describe the nutritive value of the potentially important clams which could supplement our protein diet.

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Table 1. Biochemical composition of three edible bivalves from Bahrain. Mean ± S.E. (minimum and maximum). Figures in the same column having the same superscript are not significantly different at $P \leq 0.05$.

Species	Protein (mg/mg)	Carbohydrate (mg/mg)	Total lipid (%)	Cholesterol (mg/mg)	Fresh weight (g)	Dry weight (g)
Marcia flamea	0.1790±0.01[a] (0.076-0.2745)	0.2220±0.01[a] (0.1284-0.33)	5.18±0.24 (3.2-9.6)	0.0059±0.0004[a] (0.0034-0.0108)	1.6836±0.058[a] (1.28-2.53)	0.3691±0.016[a] (0.252-0.572)
Protapes sp.	0.18195±0.01[a] (0.0859-0.2972)	0.0784±0.01[b] (0.023-0.1529)	4.72±0.32 (2.47-8.13)	0.0048±0.0002[b] 0.0013-0.0071)	3.2333±0.074[b] 2.53-4.15)	0.6108±0.020[b] 0.446-0.925)
Circenita callipyga	0.2293±0.01[b] (0.1434-0.3905)	0.0177±0.00[c] (0.0107-0.023)	5.35±0.15 (3.8-7.00)	0.0033±0.0012[c] (0.002-0.0047)	2.3220±0.092[c] (1.04-3.02)	0.4511±0.020[c] (0.189-0.648)
ANOVA F-ratio	7.02*	174.19*	1.73^{NS}	22.69*	114.46*	44.15*

* Statistically significant at $P \leq 0.05$; ^{NS} not significant.

HEAVY METALS IN AGRICULTURAL CROPS IN SAUDI ARABIA

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Introduction

There is an international concern about human intake of toxic trace elements, such as cadmium, lead, mercury and others. Intake of relatively low doses of these elements over a long period of time can cause malfunction of organs and chronic toxicity. Over the last several years increasing amounts of sewage sludge and other wastes have been applied to agricultural land to provide nutrients for crops and pastures. This practice may effect the content of heavy metals in agricultural crops. Surveys on toxic trace elements in various crops have been carried out in several countries. Studies were reported from the United States (Wolnik, et al 1983, 1985), Denmark (Hansen and Anderson 1982), Germany (Barudi and Bielig, 1980), Netherlands (Wiersma et al, 1986).

The determination of the base-line level of toxic trace elements in agricultural crops is necessary to set a plan of action. The purpose of the present study was to develop background information on some of heavy metals in selected crops in Saudi Arabia.

Materials and Methods

Samples of the crop were collected in the main production areas of Saudi Arabia. All crops were taken directly from the field and were sampled in sufficient quantities to provide a representative sample. All samples were packaged in plastic bags.

Sample Preparations

Distilled deionized water (DDW) was used exclusively in all equipment that contacted the samples during preparation which was non metallic and was scrupulously cleaned.

The edible parts of the crops as used for human consumption, were washed with deionized water, dried at 105°C and ground in a special mill with provisions to prevent contamination.

Sample Analysis

The dried crop samples were digested in aquartz dishes by stepwise raising the temperature to 450°C. After ashing, NHO_3 was added and the sample was heated until white ash appeared. The ash was dissolved in 3M Hcl.

All metal ions were analysed with atomic absorption spectrophotometry. The analyses were performed on a Perkin-Elmer Model 1100B atomic absorption spectrophotometer. Mercury and Arsenic levels were measured by a cold vapor generation technique.

Results and Discussion

Cu, Fe, Zn, Pb, Cd, Hg and As contents of eight crops which were collected from five different regions of the kingdom are illustrated in Tables 1 and 2. The level of Fe was the highest in parsley, 3.67 mg/100g (1.0 - 10.8 mg/100g), followed by lettuce, 1.1 mg/100g (0.3 - 5.4 mg/100g), green onion, 0.67 mg/100g (0.3 - 1.3 mg/100g), Kusa, 0.6 mg/100g (0.5 - 0.6 mg/100g). Whereas for other crops it was less than 0.4 mg/100g.

Cu was significantly higher in parsley, 0.2 mg/100g (0.09 - 0.55 mg/100g) compared with other crops. Zn was also found to be high in parsley (0.4 mg/100g), but there was no significant difference between the level of zinc in various crops.

Pb was significantly higher in parsley (0.02 mg/100g) compared with other crops. The average contents ranged <0.001 - 0.003 mg/100g and the middle region had the highest level of zinc compared with others (.001 - 004 mg/100g).

The Cd level was significantly higher in green onion, lettuce, kusa, onion, carrot (0.001 - 0.004 mg/100g) and the middle region had the highest level of Cd (0.0046 mg/100g).

All crops were free of Hg and As except in tomato sample but in levels below the detection limit. In general Cd and Pb levels in our study did not differ greatly from those reported in the literature (Table 3).

The heavy metal contents of three frozen vegetables collected from the market are shown in Table 4. All frozen vegetables were free of Cd and As. About 50% of potato sample and 30% of peas were free of Pb. Fe, Cu and Zn levels in potatos were less than in mixed vegetables, while the peas had the highest level.

The content of Fe, Cu, Zn, Pb, and Cd in seven canned foods are presented in Table 5. The Fe level was the highest in black and green olives (3.753 mg/100g and 2.165 mg.100g, respectively), followed by green peas and tomato paste (2.017 mg/100g and 1.91.3 mg, respectively). There was no significance difference between chick peas, white peas and peas in the content of Fe. In tomato paste there was a difference between the brands (0.54 - 10.53 mg/100g), these might be due to contamination of Fe in some of tomato paste from the metal or during the processing. Also the level of Cu in Tomato paste and white peas in some brands was higher than others.

All the samples were free of As and Hg. Green peas and chick peas were free of Cd, while tomato paste contains an average of 0.0094 mg/100g for Cd, and 0.142 mg/100g for Pb. About 50% of chick peas were free of Pb.

Existing legislation suggests an upper limit of 2 Ppm for Pb in canned foods . The level of lead obtained in this study did not exceed this limit but there is a high probability that such a toxicant could gradually acumulate above the recommended limit.

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Table 1.

Amount of heavy metals mg/100g in vegetables

Vegetable	No. of Sample	Range	Fe	Cu	Zn	Pb	Cd
Local tomato	10	Mi n	0.1220	0.0300	0.0650	0.000	0.000
		Max	0.2870	0.2010	0.1440	0.0032	0.00280
		Mean	0.2225^{c}	0.1207^{b}	0.0993^{cd}	0.0016^{b}	0.00083^{bc}
Imported tomato	4	Min	0.1810	0.0380	0.0780	0.0100	0.00056
		Max	0.2990	0.2380	0.0980	0.0030	0.00260
		Mean	0.2410^{c}	0.1060^{bc}	0.0865^{d}	0.0020^{b}	0.000137^{abc}
Lettuce	32	Min	0.3040	0.0270	0.0830	0.0000	0.0000
		Max	5.4420	0.2600	0.3710	0.0104	0.03683
		Mean	1.1390^{b}	0.0178^{cde}	0.1628^{bc}	0.0032^{b}	0.00445^{a}
Green Onion	28	Min	0.3160	0.0290	0.0800	0.000	0.000
		Max	1.3400	0.1170	0.3940	0.0032	0.00527
		Mean	0.6762^{bc}	0.073^{cde}	0.1790^{b}	0.0018^{b}	0.00101^{abc}
Imported Onion	4	Min	0.1680	0.0470	0.0490	0.000	0.000
		Max	0.6330	0.1090	0.1360	0.0054	0.00150
		Mean	0.3020^{c}	0.0662^{de}	0.0700^{d}	0.0016^{b}	0.00073^{c}
Egg Plant	7	Min	0.2470	0.0381	0.0151	0.000	0.00060
		Max	0.6660	0.1340	0.2222	0.0053	0.00130
		Mean	0.3797^{c}	0.0821^{cde}	0.1035^{cd}	0.0012^{b}	0.00007^{c}
Parsley	31	Min	0.9930	0.0900	0.1780	0.0213	0.000
		Max	10.8300	0.5470	0.7220	0.0625	0.01731
		Mean	3.3720^{a}	0.1969^{a}	0.4073^{a}	0.0180^{a}	0.00417^{ab}
Kusa	7	Min	0.5010	0.0690	0.2160	0.0060	0.0000
		Max	0.6930	0.1460	0.5130	0.0063	0.00120
		Mean	0.6061^{bc}	0.1032^{bcd}	0.3527^{a}	0.0026^{b}	0.00044^{c}
Carrot	33	Min	0.1030	0.0310	0.0820	0.0000	0.0000
		Max	0.6090	0.0950	0.2360	0.0042	0.00284
		Mean	0.2950^{c}	0.0512^{e}	0.1390^{bcd}	0.0012^{b}	0.00095^{abc}
Cucumber	36	Min	0.1140	0.0210	0.0770	0.0000	0.0000
		Max	0.4040	0.1250	0.7750	0.0016	0.00450
		Mean	0.2021^{c}	0.0502^{e}	0.1658^{bc}	0.0006^{b}	0.00044^{c}

* Average with same letter have no significant difference at ($P<0.05$) .

Table 2

Metals (mg/100 g) wet weight in vegetables according to region.

Region	no.	Fe	Cu	Zn	Pb	Cd
Middle	58	1.8887[a]	0.1176[a]	0.2286[a]	0.0168[a]	0.00464[a]
East	20	0.7829[b]	0.0691[b]	0.1841[a]	0.0042[b]	0.00117[b]
West	44	0.5378[b]	0.0837[b]	0.1968[a]	0.0020[bc]	0.00095[b]
North	33	0.7860[b]	0.0755[b]	0.2026[a]	0.0011[c]	0.00133[b]
South	32	0.6629[b]	0.0810[b]	0.1750[a]	0.0038[bc]	0.00179[b]

* Average with same letter have no significant difference at ($P<0.05$) .

Table 3.

Amount of Cd, Pb in some vegetables compared with other studies (mg/100 g)

Crop	Mean	Country	Reference
Cd			
Lettuce	0.004	Saudi Arabia	This study
	0.005	TheNetherlands	Wiersma, D. et al., 1986
	0.0024	Denmark	Hansend and Andersen, 1982
	0.003	Germany	Barudi and Bielig, 1980
	0.0029	Sweden	Fuchs et al., 1976
	0.0026	U.S.A.	Wolnik et al., 1983
Cucumber	0.0004	Saudi Arabia	This study
	0.0003	The Netherland	Wiersma, D. Et al., 1986
	0.0003	Sweden	Fuchs et al., 1976
Carrot	0.0010	Saudi Arabia	This study
	0.004	The Netherland	Wiersma, D. et al., 1986
	0.009	Great Britain	Min. Agr. Fish Food, 1973
	0.004	Sweden	Fuchs et al., 1976
	0.0028	U.S.A.	Wolnik et al., 1985
Green Onion	0.0010	Saudi Arabia	This study
	0.0011	U.S.A.	Wolnik et al., 1985
	0.004	Great Britain	Min. Agr. Fish Food, 1973
	0.001	Sweden	Fuchs et al., 1976
Pb			
Lettuce	0.003	Saudi Arabia	This study
	0.0013	U.S.A.	Wolnik et al., 1983
	0.016	Germany	Barudi and Bielig, 1980
	0.0045	Denmark	Hansend and Andersen, 1982
	0.0043	Sweden	Fuchs et al., 1976
Cucumber	0.0006	Saudi Arabia	This study
	0.0005	The Netherland	Wiersma, D. et al., 1982
	0.0013	Sweden	Fuchs et al., 1976
Carrot	0.0012	Saudi Arabia	This study
	0.005	The Netherland	Wiersma, D. et al., 1982
	0.0009	U.S.A.	Wolnik et al., 1985
	0.0021	Sweden	Fuchs et al., 1976
	0.004	Great Britain	Min. Agr. Fish Food, 1973
Green Onion	0.0008	Saudi Arabia	This study
	0.0005	U.S.A.	Wolnik et al., 1985
	0.006	Great Britain	Min. Agr. Fish Food, 1973
	0.001	Sweden	Fuchs et al., 1976

Table 4.

Amount of Heavy Metals (mg/100 g) in Canned Vegetables

Product	No. Of Samples		Fe	Cu	Zn	Pb	Cd
Tomato paste	11	min	0.540	0.132	0.219	---	---
		max	10.530	1.060	0.809	0.9810	0.0230
		av	1.913 B	0.456 AB	0.485 B	0.1421 A	0.0094 A
Chick peas	5	min	0.992	0.307	0.506	---	---
		max	1.410	0.506	1.430	0.0150	---
		av	1.306 C	0.364 B	0.889 A	0.0058 C	---
Green peas	3	min	1.190	0.128	0.004	---	---
		max	3.660	0.240	0.437	0.0037	---
		av	2.017 B	0.173 B	0.189 C	0.0012 C	---
White peas	7	min	0.667	0.269	0.571	---	---
		max	1.730	1.173	0.830	0.0050	0.0014
		av	1.302 C	0.803 A	0.645 AB	0.0007 C	0.0002 A
Peas	6	min	0.760	0.187	0.400	---	---
		max	1.568	0.512	0.987	0.0092	---
		av	1.263 C	0.344 B	0.792 A	0.0015 C	---
Green Olive	7	min	0.388	0.	0.	---	---
		max	6.180	0.361	0.253	0.0250	0.0033
		av	2.165 A	0.290B	0.117 C	0.0066 C	0.0012 A
Black Olive	6	min	0.848	0.272	0.042	---	---
		max	6.870	0.750	0.538	0.3380	0.0040
		av	3.753 A	0.449 AB	0.169	0.0972 B	0.0011 A

* Average with same letter have no significant difference at ($P<0.05$) .

Table 5.

Amount of Heavy Metals (mg/100 g) in Frozen Vegetables

Vegetable	No. Of Samples		Fe	Cu	Zn	Pb	As	Cd
Mixed vegetable	7	min	0.7271	0.1603	0.2593	0.0133	---	---
		max	1.8952	0.3623	0.8594	0.0658	---	---
		av	1.2166 AB	0.3034 A	0.4547 B	0.0310 A	---	---
Potato	9	min	0.0821	0.0962	0.1092	0.0000	---	---
		max	1.3325	0.3911	0.7346	0.0391	---	---
		av	1.0402 B	0.2206 AB	0.3367 B	0.0171 A	---	---
Peas	9	min	1.3284	0.1732	0.5972	0.0000	---	---
		max	2.3631	0.6134	1.3311	0.0820	---	---
		av	1.7139 AB	0.3350 A	0.8751 A	0.0261 A	---	---

* Average with same letter have no significant difference at ($P<0.05$) .

FOOD CHEMICAL CONTAMINANTS IN SHARJAH EMIRATE

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Introduction

The application of chemicals in crop and farm animal production and for food preservation and organoleptic quality modification, in addition to unintentional contaminants, has eventually resulted in new additions to food components. Contaminants such as heavy metals, migrants from packaging material, trace organics, colour impurities, pesticide residues, hormones, antibiotics, radionuclides, and biocontaminants (aflatoxins), have aroused great health concerns. In view of the risks encountered from human ingestion of these non-nutritional components of foods, these potential chemical hazards need to be outlined and continuously monitored. Reported toxicities of contaminants and some additives range from allergic symptoms to carcinogenicity. Consequently, the application of reliable analytical methodology, leading to their susccessful determination, has emerged.

This paper reviews some of results related to food contaminants in Sharjah Emirate in United Arab Emirates.

Food Colour Contaminants

Food colour contaminants are mainly inorganic salts or other undesirable colours resulting from the manufacturing process when Good Manufacturing Practice (GMP) is not followed. The Joint FAO/WHO Expert Committee had shown concern about colour specifications and colour impurities; and the EEC, FAO and the AGCC Standardization and Metrology Organization have all given good accounts of permitted colours, colour standards of purity and ADIs in their specifications.

Concentration of colours in soft drinks analysed by our laboratory showed 107 ppm of SY in orange AH; 164 ppm SY in Oranub, and a combination of SY (E110) and tartarazine (E102) in Mango AH showing concentrations of 48 and 44 ppm for the two colours, respectively. Mixed AH contained SY at a concentration of 25 ppm. Careful consideration of such data is needed in view of the ADIs given in the different standard specifications for synthetic food colours. Amaranth (E123), which is prohibited under AGCC standard specifications was detected in fruit drinks and as an impurity in saffron.

Aflatoxins

Aflatoxin is one of the most carcinogenic, mutagenic and teratogenic substance found naturally in many food and feeds. It is secreted by toxigenic strains of the fungus

Aspergillus flavus/parasiticus (Coulombe, 1991). Although it was believed, first, that groundnut was the only agricultural product containing aflatoxin, the number of products now being recorded to support toxin synthesis has increased dramatically (Ellis et. al., 1991). In our laboratory, analytical findings led to rejection of seaport samples of nuts and dry figs for exceeding the acceptable aflatoxin maximum limit of 20 ppb. This stimulated the analytical surveying of some fruits among which was date fruits (Phoenix *dactylifera*-L). In our first experiments, date fruits were found to be contaminated with aflatoxins. Since there was no literature background on aflatoxins in dates, this prompted the urgency of a preliminary survey to study the possible formation of aflatoxins in date fruits. This was encouraged by previous reports (Abu Zinada, 1982; Saxena et al., 1988), who confirmed the natural presence of toxigenic fungi on date fruits. The first analytical study indicated the detection of aflatoxins B_1 and G_1, in date fruits of the variety Buchibal at the Khalal stage, at levels of 113 and 133 µg/kg, respectively. Consequently, intensive study of the occurrence of aflatoxins in date fruits of different varieties and at different stages of maturity (in relation to the fruits chemical composition, previously studied by Ahmed et al., 1995), was carried out. The study included the determination of susceptibility of different date varieties to aflatoxin production, which involved inoculation of fruit segments, incubation and extraction and clean-up of aflatoxins extracts by Best Food (BF) procedure of the AOAC (1990).

Thin layer chromatography was used as a sensitive tool for aflatoxins detection, while quantification was carried out by injection of the extracts (from the BF method), into a Hewlett Packard (HP) 1090 liquid chromatograph, connected to a programmable fluorescence detector and post-column reactor, to achieve post-column derivations (PCD) by reaction with iodine to enhance fluorescence, as described by Shepherd and Gilbert (1984). On comparing fluorescence to UV detection, using the photo-diode array detector in this study, the fluorescence detector proved to be more sensitive, more selective and less liable to background interference than UV. However, fluorescence detection suffered from the fluorescence property of aflatoxins B_1 and G_1. This could be solved by either using post-column derivatisation, which resulted in more sensitivity of the fluorescence detection for B_1 and G_1 or by use of UV for detection of B_1 and G_1 and fluorescence for B_2 and G_2, as carried out by Hurst and Toomy (1987).

Highest aflatoxin production was generally noted, in the Khalal stage of ripening (Table 1). This stage of ripening has been noted for high moisture and appreciable amount of sugar formation (needed as a source of carbon for aflatoxin synthesis). At the Rutab stage the higher sugar formation and lower moisture content led to lower aflatoxin production than in the Khalal stage. It could be the moisture/sugar balance in addition to other factors such as high zinc (known to favour aflatoxin production, such as in the Kimri stage), are the factors responsible for aflatoxin production.

The survey indicates that among the foodstuffs which are considered notable for aflatoxin contamination, such as nuts, cereals, dried fruits and baby foods, also, fresh fruits such as dates may be considered. The EEC Council Regulation No. 315/93 has included aflatoxins among other food contaminants.

In view of the laboratory findings indicating high incidence of aflatoxins in certain imported food items such as nuts, coconut powder, pasteurized fresh milk, camel's milk,

cows milk and mothers milk (Saad, 1987), and the findings in this study, in relation to the differing regulatory actions in different countries, it is the time to establish local limits for aflatoxins in foods. In the meantime, rejection of foodstuffs containing high toxin, exceeding the limits, in U. A. E., is mainly based on EEC, FAO and American F. D. A. limits, and local routine analysis is carried out by local laboratories, in U. A. E., hopefully to enable the Technical Committee of the General Secretariat of U. A. E. Municipalities to adopt local limits, in regulatory form.

Table 1. Aflatoxin production by *A.parasiticus* (IMI 91096) grown on date segments of different varieties at Khalal stage*. (Mean of 6 replicates).

Variety	B1	G1	B2	G2	Total
Naghal					
Mean:	72.3	163.9	4.1	8.6	248.9
(S.D):	(11.78)	(0.10)	(12.16)	(2.69)	(12.16)
Buhibal					
Mean:	120.3	234.7	11.4	11.9	378.3
(S.D.):	(25.63)	(2.71)	(2.90)	(2.24)	(73.48)
Gush Rabie					
Mean:	43.3	60.0	2.0	1.8	107.1
(S.D.):	(3.78)	(4.13)	(0.10)	(0.17)	(0.4)
Lulu					
Mean:	26.3	37.4	1.1	1.0	56.8
(S.D.):	(2.64)	5.23)	(0.11)	(0.14)	(8.05)
	ND	ND	ND	ND	NIL

*** Late maturing variety.**

Metals

Metals have been known to enter the human food chain from different sources. Since metals, in most cases, are undesirable, especially when they exceed the limits, they are generally regarded as food contaminants. This is despite the fact that some metals are essential for some nutritional or cellular functions in the human body, such as manganese, zinc and selenium, although the later can be toxic when present in the food in a higher dose than required or in the selenite form. The sources of contamination can be environmental or due to methods of food production and processing.

The most conveniently carried out routine tests in our laboratory are for mercury in fish, metal analysis (e.g. lead, arsenic, copper and cadmium) in well waters, lead and tin in beverages and canned fruits, where can swell due to hydrogen gas evaluation in addition to flavour changes and discolouration which may occur in the case of uncoated metals e.g. aluminium cans. Mercury in fish determination has become important to validate export certificates. Although our analytical surveys have generally indicated less than trace amounts in U. A. E. fish, with very few exceptions, it is very important to perform analysis on fish required for export since importation and re-export trade is frequently practised in the region. Table (2) shows some of the findings from analysis carried out on local fish of different types. The findings range from 0.05 to 0.41 mg/kg fish. On considering the Codex Alimentarius Commission provisional tolerable weekly intake for humans of about 0.0033 mg methyl mercury/kg body weight (i.e. about 0.2 mg per week for an adult of an average weight of 60 kg), and in view of the long biological half-life of methylmercury (120 days) in the blood, considerable care should be taken to set safe tolerable limits of methylmercury in fish and sea foods.

Table 2. Mercury in different fish species

Fish name	Mercury content
Fish (Red)	0.10
Cuttle fish	<0.05
Lobsters (Oman)	0.05
Fish (yellow fin tuna loins)	0.05
Grouper fish	0.05
Red sea bream fish	0.05
Emperor fish	0.05
Fish (shak trunk)	0.41
Goat fish	0.15

Pesticide Residues

Pesticides are chemical compounds used for the control or eradication of plant pests, in general. They are found in the sub-groups; Organophospours compounds which are generally insecticides e.g. Malathion; Organochlorine compounds which are insecticides and acaricides e.g. chlorbenzilate; Carbamates which are insecticides, nematicides and bird repellents e.g. dithiocarbamates and carbosulfan; Pyrethroids which are insecticides e.g. permethrin; organic and inorganic fungicides e.g. Bordeaux Mixture, copper compounds, sulphur and carboxin (organic systemic fungicide) and Rodenticides (e.g. zinc phosphide and warfarin). Since these pesticides represent long lists of chemical compounds which are considered hazardous to human and animal health, many

countries have limited the use of pesticides to short lists which are regarded as safe, when used within the limits specified for the residues in the final products of foodstuffs, e.g. fruits, vegetables, meat and milk. More hazard can be encountered from the in-product than on-product residues, which are mostly washable by water.

In our laboratory, the extraction and clean-up procedure followed was that of the AOAC Official Method of Analysis. The results indicated that the levels of organochlorines and organophosphates were lower than maximum limits in vegetables namely tomatoes cucumber, lettuce, cabbage and garden cress. Similar local produce (tomatoes, cucumber and lettuce) was previously monitored in Abu Dhabi Food and Environment Control Centre for the series of persistent organochlorine pesticides and the results indicated of 0.02 mg/kg of material for DDT and 0.01 mg/kg for each of dieldrin, HCB and a-ß and ∂-HCH (lindane) in these vegetables. All detections, as given by Ahmed (personal communication), were below the maximum residue limits.

With respect to the pesticide contamination of foods, it seems that the situation calls for amendment in the whole region so as to adopt competent technical methodology, revise the toxicological status and develop ADIs, by accredited reference laboratories. The whole policy, however, especially with regards to the lists of pesticides applicable, should be implemented in collaboration with the Ministry of Agriculture and Fisheries.

Packaging Material

The occurrence of minor constituents in packaging material is of growing public health concern. Some of these constituents, which are incidental residues rather than deliberate additives, have been regarded as unsafe. One of these, Vinyl Chloride Monomer (VCM) in polyvinyl chloride (PVC), is regarded as carcinogenic, when ingested by man or animals.

Although the threshold value for its carcinogenicity has not been established, carcinogenesis in mice, from inhalation of VCM, has previously been reported (Maltoni and Lefemine, 1974), and tumours in the internal organs of workers in PVC plants have been noted. Accordingly, the VCM content of PVC material used for foodstuffs packaging became a public health concern, since migration of these residues into foods could take place. In addition, the monomer migration into food led to organoleptically detectable taint. Studies on migration of VCM (regarded as the solute) from package into food material have indicated that migration to food material e.g. a drink (regarded as the solvent), is dependent on the ability of the solvent to desorb chemically the residue from its active site in the polymer (Wilks and Gilbert, 1972). The partitioning of VCM between solvent and polymer is governed by mass action laws and distribution law for the "unbound" excess monomer (Morano, 1975). Possibilities of migration of monomer into food warranted analytical monitoring of VCM in packages and in foodstuffs in contact with the packaging material. This, has also, alerted public health concerns which resulted in the drafting of limits. The US Food and Drug

Administration (FDA), UK and EEC have put a highest limit of 1.0 ppm VCM in plastics and 0.01 ppm migrant in the food material.

Results of a survey carried out in our laboratory for detecting VCM in drink and water samples in PVC containers, VCM was undetectable with the exception of a mineral water bottle stored for over a year at 40^0C, in the production factory. This has shown VCM content of 0.15ppm. The results of zero VCM for lemon, grape, orange and strawberry drinks, which are all acidic in nature, and packed in containers of 0.1-0.3 ppm VCM content, indicate that legislative limits for VCM content of PVC have been laid down on careful measures (Table 3)

Complaints due to off-odours or taints, which are thought to be solely due to the PVC bottle, were encountered in locally-produced milk plastic bottles. But, the analysis could not indicate any detectable monomer. It is not conceivable why the organoleptically detectable taint, could not be analytically accounted for, since VCM content, which was sometimes nil in the PVC bottles, was always organoleptically detectable. This was thought to be due to the multiplicity of the factors responsible for the taint. Legislation is certainly lacking in this area and the possibility of very low threshold values for the sensory detection of taint due to VCM or their residues, in plastic containers needs further investigation. Likewise, investigations are expected to be underway for development of methods of detection of other volatile monomers such as vinylidene chloride used in the preparation of vinylidene chloride copolymers (Stretch films) for microwave oven use. MAFF Science Laboratory, U.K. have carried out active roles in this connection.

Table 3. VCM content of some test samples

Test sample	VCM in plastic (mg/kg)
PVC	0.66
Q-200	1.3* (SD=0.005)
Q-400*	1.1* (SD-0.003)
PMW-11**	0.3** (LFRA=0.7) (SD=0.01)
PVC bottle Dec-94	0.3 (SD=0.01)
PVC raw 0.31	

Food Additives

The food additives, which have been under investigation in U.A.E. for the last thirteen years, in fresh or processed, imported or for locally-produced foods, fall within the following:

1- Preservatives e.g. sodium benzoate.
2- Antioxidants e.g. butylated hydroxy toluene (BHT)
3- Colours e.g. azo-dyes
4- Non-nutritive sweeteners e.g. saccharin
5- Flavour modifiers e.g. vanillin
6- Clouding agents e.g. brominated vegetable oils in soft drinks.

A full account of most of the above-mentioned additives (preservatives, sweeteners and flavourings), their levels in imported and local beverages in view of the available legislation and developed analytical methods, was previously reported (Ahmed, 1989).

More violations of local, AGCC and overseas legislation have been encountered in the form of non-declared colours and non-nutritional sweeteners, and high sodium benzoate or other preservative, apparently to conceal poor manufacturing practice. High levels of sodium benzoate in imported drinks and other foods were found to be due to differences in international standards e.g. US FDA standards which allow high benzoate levels in comparison with EEC, British legislation, and the local limit. As in the case of all chemical additives, it is required to have stringent guidelines based on long-term toxicological studies in order to safeguard the suspicious consumer against hazardous chemicals such as preservatives, synthetic colours, which are prohibited in some countries. It should be generally accepted that no food additive can be proved to be absolutely safe; however, it may be more of a benefit in the risk/benefit balance. For example, nitrites and nitrates destroy the poisonous Clostridium botulinum bacteria in preserved meat, but there is the risk of conversion of nitrities into nitrosamine which are known to be carcinogenic to animals. Monosodium glutamate (E621) or MSG, a flavouring additive used in meat and potato, which are consumed by small children, has not been allowed in foods manufactured for babies and infants. It is claimed to cause palpitation, chest or neck pain and dizziness. Some precautionary measures have been taken against MSG since it caused what is known as the "Chinese restaurant syndrome" (Fox and Cameron, 1995).

From the foregoing, it is in the authors view that severer measures should be undertaken in the region to reduce additive hazard to a minimum. Local legislation is needed to play more active roles.

Other Contaminants

Veterinary residues which are mainly considered are antibiotics for animal treatment and growth promoters or anabolic hormones, used for increase of growth rate, reduce food required for growth and for tissue redistribution from fat to lean. The use of

hormones in meat was banned by the EEC in 1988. The use of antibiotics by farmers indiscriminately has been opposed, since low doses are known to lead to the development of antibiotic resistance by micro-organisms and lead to what is known as infective drug resistance, which is transmissible to humans. Chloramphenicol is the antibiotic used for treatment of animals and since it is the effective drug in the treatment of Salmonella typhi in humans, care must be taken by farmers and food quality controllers to dictate a special policy in this regard. A special policy is required, also, since consumers allergic to certain antibiotics may get ill.

In our laboratory, a testing of locally-produced fresh milk from seven farms, indicated that the milk from two farms contained the antibiotic. The method used was the Lacarete test method, which is based on qualitative enzyme-linked immuno-assay, with a sensitivity of 10 ppb.

Radioactivity should be considered as a serious contamination of foods. Imported powder milk, tea, animal feed tested were found to contain radionuclides (Cs-137 and Cs-134), in high counts of over 2000 Bq/kg.

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ANNEX 1

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WORKSHOP ON ESTABLISHING FOOD COMPOSITION DATA FOR THE ARAB COUNTRIES OF THE GULF (GULFOODS)

AL-AIN, UAE, NOVEMBER 21 - 23, 1995

Scientific Programme

Tuesday, November 21, 1995

8 : 00 - 9 : 00	**Registration**
9 : 00 - 9 : 30	**Opening Ceremony**
9 : 30 - 10 : 00	Coffee Break

First Session (10 : 00 - 12 : 00)

Chairman : N. Abuirmelh *(UAE University - Al-Ain)*

10 : 00 - 10 :30	FAO prospective on international food composition activities - **C. Lewis (FAO/Rome)**
10 : 30 - 11 : 00	Current status of the global network of INFOODS data base - **N. Scrimshaw (UNU/Boston)**
11 : 00 - 11 : 30	Food composition activities in the Near East - **S. Miladi (FAO/RNE)**
11 : 30 - 12 : 00	Setting priorities for food composition tables - **D. Buss (Hampshire / UK)**
12 : 00 - 12 : 15	Coffee Break

Second Session (12 : 15 - 13 : 30)

Chairman : C. Lewis *(FAO/Rome)*

12 : 15 - 12 : 40	Validation of analytical methods for establishing food composition data - **J. Prodolliet (Nestle' Research Centre / Switzerland)**
12 : 40 - 13 : 05	Dietary fibre methodology for food composition database - **I. Bell (Kellogg's Company / UK)**
13 : 05 - 13 : 30	Establishing food composition tables for the Arab Gulf countries : Experience in Bahrain - **A. Musaiger (UAE University)**
13 : 30 - 16 : 00	Lunch Break

Third Session (16 : 00 - 18 : 30)

Chairman : N. Scrimshaw *(UNU/Boston)*

16 : 00 - 16 : 25	Composition of some traditional foods and dishes in the Arabian Gulf countries - **M. Ali (UAE University)**
16 : 25 - 16 : 50	Establishing standard recipes for producing food composition data for Oman - **A. Musaiger (UAE University)**
16 : 50 - 17 : 15	Towards establishing food composition tables for use in S. Arabia - **M. Al-Kanhal (King Saud University/S. Arabia)**
17 : 15 - 17 : 40	Experience of Kuwait in analysing local composite dishes - **W. Sawaya (Kuwait Institute for Scientific Research/Kuwait)**

17 : 40 - 18 : 05	Composition of camel milk and meat: Experience of Food and Environment Control Centre **M. Ahmed (Food and Environment Control Centre/AbuDhabi)**
18 : 05 - 18 : 30	Food composition activities in Qatar - **A. Kotb (Centre for Food Contamination Monitoring / Qatar)**

Wednesday, November 22, 1995

Fourth Session (8 : 30 - 10 : 30)

Chairman : M. Al-Kanhal *(KSU / S. Arabia)*

8 : 30 - 9 : 00	Food additives and contaminants in processed foods consumed in UAE - **M. Rao (Public Health Laboratory / Dubai)**
9 : 00 - 9 : 30	Composition of some edible bivalves in Bahrain - **H. Al-Sayed (Bahrain University / Bahrain)**
9 : 30 - 10 : 00	Food chemical contaminants : Occurrence, analytical methodology and legislation - **A. Ahmed (Central Food Control and Consultancy Laboratory / Sharjah)**
10 : 00 - 10 : 30	Contaminants in some selected foods consumed in Saudi Arabia - **A.Al-Khalifa (King Saud University/ S. Arabia)**
10 : 30 - 11 : 00	Coffee Break

Fifth Session (11 : 00 - 14 : 00)

Chairman : A. Musaiger *(UAE University / Al-Ain)*

WORKING GROUPS

Group 1.	Purpose of food composition tables, users and uses of food composition data, status of food composition data in the Gulf .
Group 2.	Technical issues for establishing food composition data in the Gulf (Data generation, quality, information system, etc).
Group 3.	Formulation of future plans for strengthening the national programme and identification of needs, resources, recommendations for food composition programme activities in the Gulf.
14 : 00 - 16 : 00	Lunch Break.

Sixth Session (16 : 00 - 19 :00)

Continue working groups - Drafting the reports.

Thursday, November 23, 1995

Seventh Session (8 : 00 - 10 : 00)

Chairman : S. Miladi (FAO / RNE)

- Presentation of the reports of working groups
- Conclusions and recommendations

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