

HUMAN NUTRITION

Tee E Siong
Division of Human Nutrition,
Institute for Medical Research,
Kuala Lumpur

Abstract

This paper gives an overview of nutrition research in Malaysia, from the beginning of the century when investigations into the etiology and pathology of beri-beri were actively pursued. Following this pioneering work in the Institute for Medical Research, studies into other vitamin and nutrient deficiencies were carried out by various investigators. These studies into the nutritional status of communities continued up to the present time, covering various communities and locations in the country. There has been significant advances in the parameters studied and the tools employed. Definite changes in the prevalence of specific nutrient deficiencies afflicting the communities have been observed. World-wide interest in the relationship between diet and coronary heart disease also generated considerable amount of research activities in the country from the 1960's. Studies continued up to the present time, and findings have shown that this is also a problem amongst the more affluent segments of the population. Interest in the nutrient content of local foods was already evident in the early part of the century, and a great deal of work was carried out in the 1930's and 40's. However, it is in recent years that greater emphasis has been given to this, and nutrient analysis undertaken on a more systematic approach. An inter-institutional collaborative programme has succeeded in compiling a fairly comprehensive food table in 1988. Over the years, major advances have been made to the techniques for nutrient analysis, particularly for vitamins and minerals. Studies into toxicants in foods is, on the other hand, a relatively new area of research in the country. Increasing consumer awareness on food safety has prompted studies into various food contaminants, including aflatoxin, heavy metals, boric acid, food colours and other additives.

Human Nutrition

1 Introduction

Documentation of nutrition research in Malaysia dates back to before 1900, when investigations into the etiology and pathology of beri-beri were actively pursued in the Institute for Medical Research (IMR). This pioneering work on what was later discovered to be due to a vitamin deficiency in the diet, stimulated a great deal of interest into other vitamin deficiency disorders. In the years that followed, the Institute continued to play an active role in nutrition research. Other institutions also contributed towards the characterisation and understanding of the nutritional problems in the country. Studies were carried out into other vitamin deficiencies, including xerophthalmia, rickets, pellagra, and angular stomatitis, as well as other nutrient deficiencies e.g. protein-energy malnutrition, nutritional anaemia and goitre.

Nutrition research in Malaysia took on new dimensions in the 1980's. Various other institutions in the country took on greater participation in nutrition research. There has been wider coverage of communities, and nutrition studies took on greater depth and scope. Changes in methodologies are also clearly evident. Furthermore, there is a definite change in the trends in nutrition research, with the change in the pattern of food and nutritional problems in the country as a result of socio-economic developments.

This paper gives an overview of nutrition research in the country, from the beginning of the century to the early 1990's. For each area of research, advances or changes over the years are discussed. The discussions rely mainly on the bibliographic compilations of nutrition research in the country previously published by the IMR (Tee, 1980; 1984), as well as more recent publications. It would not be possible nor desirable to cite all reports in this paper due to the limitation of space. Thus only a minimal number of references are cited, and most of these are reviews of specific topics.

2 Community nutrition studies

2.1 Assessment of nutritional status of communities.

Early investigators had already placed emphasis on

Human Nutrition

the assessment of nutritional status of communities. Several nutrition surveys of various communities in Peninsular Malaysia were reported from the 1930's to the 50's. This emphasis continued into the two decades that followed. Most of the studies were in the rural areas, and several comprehensive surveys of various communities in Sarawak, including the aborigines were also documented.

From the 1980's, researchers continued to monitor the nutritional status of the population through various studies. Communities in Sabah were also studied through several comprehensive surveys. In recent years, several more institutions have also undertaken studies in this area. Most of these are the recently established local universities. Hence, even though there has been no large scale national nutrition survey, all these studies have contributed towards a better understanding of the nutritional status of the communities. Tee and Khor (1986) and Tee (1991a, 1991b) have recently reviewed the current nutritional status of Malaysians. In the multi-authored country paper prepared for the International Conference on Nutrition organised by the FAO/WHO, a thorough review of the nutrition situation has been given (Tee and Cavalli-Sforza, 1992). The paper also gives a description and analysis of factors affecting the nutritional status of communities as well as the programmes and interventions that have been carried out.

An important development in this area is the implementation of the National Nutrition Surveillance System by the Ministry of Health in 1982. Various health and nutritional indicators have been collected to provide a national nutritional profile of the reference used. Varying references, usually from western countries, were used in studies prior to 1960. Subsequently, the Harvard Standard was used by most investigators. In recent years, more investigators are using the NCHS reference recommended by WHO. At the same time, various efforts have been made to derive a reference based on the Malaysian population.

Clinical examination has also been an important part of surveys over the years. This is especially prominent in earlier studies when diagnosis of nutrient deficiencies had to rely on this since biochemical determinations were minimal.

Human Nutrition

In the early studies, biochemical determinations were seldom a part of the surveys. Even if they were included, these were confined to haemoglobin determination. In later studies, several biochemical determinations were employed by some investigators with the required laboratory backing. The parameters frequently determined were haemoglobin, serum total protein and protein electrophoresis, serum vitamin A and carotene, and urinary urea, creatinine and hydroxyproline determination, as well as stool examination for helminth ova. In recent years, biochemical determinations remain confined to a few laboratories with the necessary facilities.

Food consumption data were also collected in the earlier studies in the country. Adequacy of intake was compared to western references or those from WHO. From the 1960's, a great deal more data on food consumption and pattern have become available. Computed intake have frequently referred to the RDA suggested by S.T. Teoh in 1973. In some recent as well as on-going investigations, data on food consumption of urban communities are also being collected. Other related data documented are the numerous reports on food habits, infant and young child feeding practices and the socio-cultural aspects of food and nutrition. An important development in relation to this is the initiation of studies into energy requirements of communities in recent years.

Early studies had already emphasised the multifactorial nature of the malnutrition problem and thus, most of these examined the socio-economic background of the communities. This aspect continued to be given emphasis in recent studies, in order to understand the ecology of each community.

2.2 Studies on specific nutrient deficiencies

Protein-energy malnutrition

Cases of clinically manifest protein-energy malnutrition have rarely been reported in surveys of community nutrition status. In a series of studies of poverty villages in Peninsular Malaysia by the IMR, in which a total of 3,584 persons were examined clinically, no such cases were encountered. Nevertheless, considerable amount of mild to moderate malnutrition occurs in various

Human Nutrition

rural and urban communities. A relatively high prevalence of chronic undernutrition ("stunted") and "underweight" amongst rural pre-school and school children have been reported in various studies, based on anthropometric measurements. The prevalence of acute malnutrition ("wasted") and severe chronic undernutrition ("stunted" and "wasted") were, however, minimal. Various studies have shown that growth achievement of rural children was clearly lower than that of their urban counterparts. Growth achievement of the latter group of children, particularly height for age, was found to approximate the NCHS median. It is thus clear that rural children have not had the chance to reach their full growth potential, but when given adequate food and an improved environment, they will certainly grow the way their urban peers do.

Vitamin B1 deficiency

The earliest nutrient deficiency investigated in the country was beri-beri, actively pursued at the beginning of the century. Extensive reports on studies into the etiology and pathology of the disease were already documented by H. Wright in 1902, the first director of the newly established IMR. This work was carried on by the three subsequent directors of the Institute, C.E. Daniels, H. Fraser and A.T. Stanton. Voluminous literature on the subject, documented by these and other investigators in the country were already available by 1920. The testing of the various hypothesis on the etiology of the disease, how the disorder was connected with rice in the diet, and finally the establishment of the relationship between vitamin B1 and the disease have all been documented in these reports. After this peak period of activities on beri-beri research, reports on the subject declined. By the 1960's, the problem appeared to have been largely overcome, as no further reports on the subject were documented.

Vitamin A deficiency

Vitamin A deficiency was actively investigated in the country around the late 1920's, after the commotion created by vitamin B1 deficiency had been somewhat resolved. In the three decades that followed, several other reports on the deficiency were documented. These were all based on clinical observations of communities, and hence

Human Nutrition

only those with manifest keratomalacia were detected. Successful treatment with vitamin A rich foods were also reported. In the 1960's and 70's, biochemical determination of serum vitamin A and carotene began to be carried out in selected laboratories (Tee, 1992).

The vitamin A deficiency problem continued to be given emphasis in the eighties. In the nutrition surveys discussed earlier in this paper, examination for clinical signs of this vitamin deficiency were often carried out. However, biochemical data on vitamin A status are still relatively scarce since few laboratories are equipped to carry out the determination. More importantly, this is related to the problem of obtaining sufficient blood from children for the determination.

Nutritional anaemia

Although the earliest documented study on nutritional anaemia in the country was in the early part of the century, literature on the subject was scarce for two decades. It was only from the thirties that momentum in this area of research picked up. Some of the studies of nutritional status of communities discussed in the previous section had looked into the prevalence of anaemia. Diagnosis was mainly by haemoglobin determination, and sometimes by blood picture examination. The period of most active research in nutritional anaemia is probably the 1950's, when P.W.G. Tasker of the IMR documented numerous studies carried out on various communities, mainly amongst pregnant women.

In the 60's and 70's, anaemia prevalence continued to be given emphasis by various investigators studying the nutritional status of communities. Due to the constraint of laboratory facilities, many of these still relied solely on haemoglobin determination and clinical examination for the diagnosis of the disorder. However, a few laboratories were able to include other biochemical parameters in their studies such as various blood indices, serum iron and transferrin saturation levels. As with the vitamin A determination problem, the small volume of blood available from children usually did not permit these determinations to be carried out during field nutrition surveys. In recent years, following developments in diagnosis methodology elsewhere in the world, other biochemi-

Human Nutrition

cal parameters are being employed, including serum ferritin and serum folate levels. However, the general situation regarding biochemical diagnosis of anaemia in most laboratories have not changed much compared to the 70's.

Nutritional anaemia appears to remain a problem of considerable magnitude in the eighties, particularly among children and during pregnancy, as seen from the various surveys carried out in recent years (Tee, 1985). A recently concluded study by the IMR examines the impact on growth and iron nutritional status of alternative interventions in anaemia associated with hookworm disease. The effects of iron salt supplementation and hookworm eradication were studied in a group of primary school children. Another study on anaemia examined the effect of iron supplementation on mental ability and scholastic performance of school children.

Endemic goitre

Studies into iodine deficiency goitre appear to have a relatively late start in the country. Although Vickers and Strahan in 1936 had reported on the incidence of goitre in Kedah, few studies in this area were documented after that. The report of I. Polunin in 1951 on goitre amongst Malays and aborigines was the only other documentation available prior to 1970. This lack of literature on the subject is also because the problem is relatively less prevalent than other nutritional problems discussed above, particularly in Peninsular Malaysia.

Several reports on goitre were documented from the 1970's up to the present time. These were mostly on communities in Sarawak, where the problem is now known to be of a considerable magnitude. The prevalence, etiology and pathology of the problem in this East Malaysian state are highlighted in a review by Tan (1982). To obtain recent data on the prevalence and etiology of the problem in Kedah, the IMR has just concluded a study of 1,075 subjects in 7 villages in the state. Whereas biochemical tests were minimal in the early studies, a host of these determinations have been carried out in these recent studies. These include T3, T4 and TSH assays in serum, and iodine and thiocyanate estimations in urine.

Human Nutrition

Other nutrient deficiencies

Other vitamin deficiencies studied in the early years include pellagra (niacin deficiency), a condition termed as "burning feet", vitamin B2 deficiency, and scurvy (vitamin C deficiency). These deficiencies did not appear to be important nutritional problems in the 60's and 70's, as well as in the 80's, as there were no further reports on these disorders.

3 Diet and coronary heart disease

Studies into overnutrition and associated disorders are relatively recent undertakings in the country. No reports in this area were documented prior to 1960. World-wide interest in the relationship between diet and coronary heart disease (CHD) also generated some research activities in the country from the 60's. Several studies on serum lipid levels of Malaysians by Y.H. Chong and co-workers of the IMR and other researchers showed that this was also a problem amongst the more affluent segments of the population. Comparative studies of Orang Asli in the deep jungle and those in the periurban and jungle-fringe have revealed low levels of serum lipids and absence of CHD in the former group, while the latter tend to have higher serum cholesterol and blood pressure values. Studies in the area have continued up to the present time. In 1988, the IMR reported a study of coronary risk factors among 406 Malaysian male executives in two urban areas, namely Kuala Lumpur and Petaling Jaya. Risk factors surveyed included hypertension, hypercholesterolemia, smoking, obesity, diabetes, high density lipoprotein (HDL) cholesterol, hypertriglyceridemia and hyperuricemia. These were found to be widely prevalent with more than half (51.5%) of the sample having one or more risk factors.

A great deal of improvement in the methodology for the determination of serum lipids have been introduced over the years. To cope with the increasing demand for these analyses, an automated method have also been established in the IMR since 1976. In recent years, the introduction of HDL-cholesterol determination has improved the assessment of CHD risk. Two recent publications of the IMR (Chong and Ng, 1985; Chong, 1986) report on current understanding of the problem.

Human Nutrition

A great deal of attention has recently been given to studies into the role of dietary fats and oil in relation to CHD. Several nutritional and biochemical studies on the use of palm oil as a dietary fat were carried out by the IMR. The digestibility, absorption and utilisation for growth of refined, bleached and deodorised palm oil and its fractions were studied using albino rats. The safety of consumption of these oils when heated was also examined. Several studies carried out by PORIM on experimental animals have shown the anti-thrombotic and the lack of atherosclerotic effect of palm oil. Studies have also shown that palm oil was able to prolong latency period prior to tumour progression and lower tumour yield. More recently, a human feeding trial to assess the effects of dietary palm olein on serum lipid levels in 80 volunteers was completed by the IMR. It was shown that palm olein is not hypercholesterolemic and may even have beneficial effects on the levels of serum cholesterol and LDL-cholesterol when included in the habitual diets. Results of some of these studies are given in recent publications of PORIM and IMR (Chong, 1987; Ng, 1989).

4 Studies on food composition

4.1 Nutritional evaluation of local foods

Interest in the nutrient content of local foods was already evident in the early part of the century, as indicated by the report of A.T. Stanton in 1923. Most of the work on the subject, however, were carried out in the 1930's and 40's. A number of reports on the analysis of selected food items and nutrients, particularly selected vitamins and minerals were reported. A few food composition tables were also published. From the 50's, reports on the subject were relatively fewer in number. Nevertheless, work carried on, and most of the data were generated from the IMR laboratory. A more detailed review of the nutrient analysis of food during the pre-eighties period have been reported (Tee, 1981).

Over the years, major advances have been made to the techniques for nutrient analysis. For instance in the analysis of vitamins, perhaps the most fascinating group of nutrients studied, dramatic changes have been made. For most vitamins, earlier work had employed biological assay procedures. Generally, by the late 1930's, these were

Human Nutrition

replaced by colorimetric, titration and fluorometric procedures. Aside from reducing the analysis time, these were also more precise and reproducible. With regards to mineral analysis, there were less dramatic changes. Nevertheless, generally, methods had changed from the earlier gravimetric to the less tedious volumetric and colorimetric methods. In the analysis of proximate composition of foods, procedures had remained essentially the same over the years. Details of these advancements in nutrient analysis techniques have been previously described (Tee, 1981). Another notable development in this field of research prior to the eighties is the analysis of fatty acid composition and cholesterol content of foods by the IMR in the 70's. These studies were carried out at the time when the Institute was very much interested in the role of dietary fats in coronary heart disease discussed above. The laboratories at the Palm Oil Research Institute of Malaysia (PORIM) in Bangi are now probably the best equipped in the country for lipid analysis.

In recent years, there has been even greater emphasis on nutrient analysis of foods, leading to increased activities in this field. More institutions in the country are playing a more active role in the generation of food composition data. The range of nutrients analysed have expanded. For example, amino acid composition of foods have been given prominence, and for the first time, work on the analysis of folate content of local foods were carried out. Whereas earlier studies had concentrated on raw foodstuffs, current analysis programme also includes the analysis of cooked foods, whose composition data is in increasing demand. There has also been greater emphasis on quality of food composition data. In relation to this, it is noteworthy to mention the establishment of linkages with institutions in other countries, for example through ASEAN Food Data Network and Asiafoods.

An important development in this area is the initiation of a programme by the IMR in the early eighties to compile and update food composition data for use in the country. As a result, nutrient analysis of foods has taken on a more systematic approach. Hence, whereas most earlier studies had analysed only a limited number of nutrients, recent activities are aimed at producing complete nutrient data for the food table. An important consequence in this regard is that the analysis programme

Human Nutrition

is a collaborative effort between the IMR, the Food Technology Division of the Malaysian Agricultural Research and Development Institute (MARDI), the Faculty of Food Science and Technology of Universiti Pertanian Malaysia (UPM), and the Department of Food Science and Nutrition of Universiti Kebangsaan Malaysia (UKM). Based on a preliminary food table published in 1982, systematic analysis of foods has been carried out and an update to the table has been published in 1985. This inter-institutional team laboured on and recently completed the compilation of a more comprehensive table which includes nutrient composition for over 500 raw and processed foods, as well as 200 cooked foods (Tee et al., 1988). The IMR is currently undertaking further studies in this area, paying particular attention to groups of local foods for which information is lacking, nutrients which have not been sufficient attention, as well as studies on analytical methodologies. Effort will also be made to improve the management, storage and retrieval of the large number of data now available. Some of the on-going studies include determination of dietary fibre, available carbohydrates, and improved methodologies for analysis of carotenoids and vitamin A.

Further improvement to the methods of nutrient analysis have been made in recent years. Although for most nutrients the techniques have remained essentially the same as those in the 70's, refinement to methodology, especially with regards to vitamin analysis are evident. In addition, there is more usage of instrumentation and semi-automation in the procedures. Some laboratories have also been able to make use of the much talked about HPLC, although data from the use of such instrument are still scarce (Tee, 1990).

4.2 Toxicants in foods

Studies into toxicants in foods is a relatively new area of research in the country. With the outbreak of Turkey 'X' disease in England in 1960, and the subsequent discovery of aflatoxin as the causative agent, investigators in the country also turned their attention towards this toxicant. Several reports on the chemical identification and analysis of aflatoxin in local foods were documented by Y.H. Chong and co-workers and G.F.J. Moir in the 60's. Reports on aflatoxin contamination of foods were few and far in between after that. However, in recent years,

Human Nutrition

there appears to be renewed interest in the subject (Mat Isa and Tee, 1984; Tee and Siti Mizura, 1984), and research is expected to pick up again in the near future.

Another food toxicant that has received attention from investigators in recent years is lead. Several reports have been documented and a study of this contaminant in 80 food items from 11 food groups was recently reported by the IMR. Yet another food contaminant studied is boric acid, an illegal food additive used by some food processors. The IMR completed a comparative study of three methods for the analysis of boric acid last year, and a survey of the extent of contamination in a variety of commonly consumed foods (Siti Mizura et al., 1991).

Increasing consumer awareness on food safety has prompted various other studies into food contaminants in recent years. These include reports on various anti-nutritive factors in foods (particularly legumes), other heavy metals such as mercury, and food additives, including colouring matters and nitrates and nitrites. In this regard, there has also been increasing interest on the association between diet and cancer development.

5. Future thrust areas

Studies on the nutritional status of communities will continue to be of concern to nutritionists in the country. The government is continuing with its socio-economic development programmes, and there is a great deal of emphasis on poverty eradication under the Sixth Malaysia Plan. There is therefore a need to continue to monitor the nutritional status and update our knowledge on the nutritional problems of the communities. The emphasis will continue to be given to rural agriculture communities, including those in Sabah and Sarawak. A collaborative study between the IMR, UPM and the Ministry of Health on the nutritional status of the major functional groups in the country has been planned for 1992 to 1995. The first phase of the study will cover various rural poor communities engaged in the major agricultural crops.

Nevertheless, as seen from some of the studies planned for the next few years, there is a definite move towards studying the underprivileged urban households as well. Another area that will gain further importance is

Human Nutrition

studies into the nutritional status of the elderly. Malaysia will participate in a multi-centre study on nutrition and the elderly proposed by SEAMEO-TROPMED.

Growth retardation resulting from protein-energy malnutrition will continue to be a problem of considerable magnitude, particularly amongst children. Anaemia, and another persistent problem, vitamin A deficiency, will continue to receive a great deal of attention. Goitre, particularly in Sarawak and Sabah, will continue to be given emphasis. There is a need to monitor national food consumption on a regular basis. In all these areas, there is expected to be improved diagnostic procedures, particularly with regards to biochemical analysis. In the other extreme, the problems associated with overnutrition will also be studied. More data on obesity, hypertension and coronary heart disease are expected to become available. In this regard, the Government has launched a national programme for the control and prevention of CHD.

Clinical nutrition research in the IMR is being strengthened in the 6th MP period. Two medical officers have recently been recruited to intensify research in this area of nutrition. A WHO consultant in clinical nutrition has also been appointed to assist in the task and he has commenced his appointment since July 1991. A new dimension in nutrition research in the IMR is expected to emerge from these new inputs.

Activities in nutrient analysis of foods are expected to continue, and on-going studies are expected to provide further data for a wider range of foodstuffs as well as nutrients. Methodologies in this area will continue to undergo refinement and improvement, in line with the goal of obtaining quality food composition data. Non-nutrient components of foods, including food toxicants, will be given greater attention in the coming years, since there is still a great deal of gaps in our knowledge in this area.

References

Chong, Y.H., and Ng, T.K.W. 1985. Association of obesity with serum lipid and lipoprotein levels. *ASEAN J. Clin. Sci.* 5(2): 124-126.

Human Nutrition

Chong, Y.H. 1986. Diet and coronary heart disease. Proceedings of the 1st Scientific Conference of the Nutrition Society of Malaysia. Nutrition Society of Malaysia, Kuala Lumpur; 31-37.

Chong, Y.H. 1987. Facts about palm oil. Palm Oil Research Institute of Malaysia, Bangi.

Mat Isa, A., and Tee, E.S. 1984. The status of aflatoxin research in Malaysia, Country Report presented at the 1st Technical Consultation of ASEAN Mycotoxins Experts, 3-8 December 1984, Kuala Lumpur.

Ng, T.K.W. 1989. Palm olein as the predominant fat in the diet of Malaysians - some major nutritional considerations. *Family Physician* 1(2): 43-46.

Siti Mizura, S., Tee, E.S., and Ooi, H.E. (1991). Determination of boric acid in foods: comparative study of three methods. *J. Sci. Food Agric.* 55:261-268.

Tan, Y.K. 1982. Endemic goitre in the state of Sarawak, Malaysia, Proceedings of the Workshop on Cassava Toxicity and Thyroid: Research and Public Health Issues, 31 May - 2 June, 1982, Ottawa, Canada; F. Delange and R. Ahluwalia (eds); pp. 64-68.

Tee, E.S. 1980. An annotated bibliography of nutrition research in Malaysia (1900-1979). ASEAN Protein Project, National Sub-Committee Malaysia, Kuala Lumpur.

Tee, E.S. 1984. An annotated bibliography of nutrition research in Malaysia: Supplement (1979-1984). ASEAN Protein Project, National Sub-Committee Malaysia, Kuala Lumpur.

Tee, E.S. 1985. Nutritional anaemias: spectrum and perspectives with relevance to Malaysia. Specialist and Reproductive Research Centre, National Population and Family Development Board Malaysia, Kuala Lumpur.

Tee, E.S. 1981. Analysis of nutrients in Malaysian foods - a review, *J. Med. Hlth. Lab. Technol. Malaysia* 7: 37-47.

Tee, E.S. 1990. Analysis of vitamins in foods. Paper

Human Nutrition

presented at the Malaysian Institute of Chemistry Seminar on Modern Techniques in Food Analysis, 4 March 1990, Johor Bahru.

Tee, E.S. 1991a. Nutrition in a rapidly developing economy - Malaysia. Proceedings of the International Seminar on Nutrition in Health and Disease, 16-18 October 1991, Manila, Philippines (in press).

Tee, E.S. 1991b. Specific nutrient deficiencies in Malaysia. Proceedings of the International Seminar on Nutrition in Health and Disease, 16-18 October 1991, Manila, Philippines (in press).

Tee, E.S. 1992. Carotenoids and retinoids in human nutrition. *Crit. Rev. Food Sci. Nutr.* 31(1/2):103-163.

Tee, E.S. and Cavalli-Sforza, L.T. (editors). 1992. Malaysia Country Paper for the FAO/WHO International Conference on Nutrition. Institute for Medical Research, Kuala Lumpur.

Tee, E.S., and Khor, G.L. 1986. Overview of country nutritional status. Proceedings of the 1st Scientific Conference of the Nutrition Society of Malaysia, Nutrition Society of Malaysia, Kuala Lumpur; pp 7-24.

Tee, E.S., Mohd Ismail, N., Mohd Nasir, A., and Khatijah, I. 1988. Nutrient composition of Malaysian foods. ASEAN Sub-Committee on Protein: Food Habits Research and Development, Kuala Lumpur.

Tee, E.S., and Siti Mizura, S. 1984. Selected food toxicants. National Council for Scientific Research and Development, Ministry of Science, Technology and the Environment Malaysia, Kuala Lumpur.

**PROCEEDINGS OF THE
90th ANNIVERSARY SCIENTIFIC
SEMINAR**

**INSTITUTE FOR MEDICAL RESEARCH
KUALA LUMPUR**

**Health Research : Achievements, Challenges
and Future Directions**

Institute for Medical Research
Kuala Lumpur
Malaysia

23-25th June 1992

**IMR 90th Anniversary Celebrations
Organising Committee**

Chairman	:	Dato' (Dr) M. Jegathesan
Members	:	Dr Mak Joon Wah Dr Ng Kok Han Dr K. Inder Singh

Scientific Seminar Organising Committee

Chairman	:	Dr Mak Joon Wah
Secretary	:	Mr Chong Hen Kee
Members	:	Dr Stephen Ambu Dr J.S. Dhaliwal Dr Patricia Lim Kim Chooi Mr J.B. Lopez Dr K. Inder Singh Dr Chiang Geok Lian Ms Haliza Mohd Riji Dr Ng Kok Han Dr Cheong Yuet Meng Dr Lye Munn Sann Dr Kevin Palmer

Proceedings of the 90th Anniversary Scientific Seminar

Advisor	:	Dato (Dr) M. Jegathesan
Editor	:	Dr J. S. Dhaliwal
Photographs	:	Mr Wong Wee Kong