

Fats and fatty acids in human nutrition

Report of an expert consultation

91



Food and Agriculture
Organization of
the United Nations

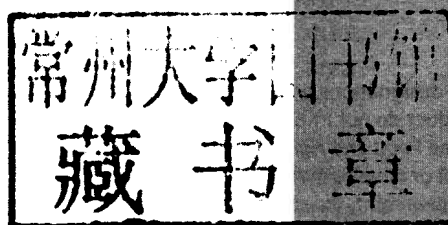
Fats and fatty acids in human nutrition

Report of an expert consultation

FAO
FOOD AND
NUTRITION
PAPER

91

10 – 14 November 2008
Geneva



The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned.

ISBN 978-92-5-106733-8

All rights reserved. FAO encourages reproduction and dissemination of material in this information product. Non-commercial uses will be authorized free of charge, upon request. Reproduction for resale or other commercial purposes, including educational purposes, may incur fees. Applications for permission to reproduce or disseminate FAO copyright materials, and all other queries concerning rights and licences, should be addressed by e-mail to copyright@fao.org or to the Chief, Publishing Policy and Support Branch, Office of Knowledge Exchange, Research and Extension, FAO, Viale delle Terme di Caracalla, 00153 Rome, Italy.

In memoriam

Professor John C. Waterlow died peacefully on 19 October 2010 at the age of 94 at the Chelsea and Westminster Hospital in London. Over the last years his body had weakened but his mind was as sharp as ever up to his last days. With his passing away, the international nutrition community has lost an exceptional nutritionist. FAO will miss this remarkable, knowledgeable, reliable and loyal friend who put all his expertise and wisdom to the service of the hungry and malnourished in different parts of the world.

Professor Waterlow spent approximately twenty years in the Caribbean region, working in Guyana, Trinidad and Tobago and Jamaica, where he established the Tropical Metabolism Research Unit at the University of the West Indies in Kingston, Jamaica and carried out his cutting-edge work on the pathophysiology and treatment of malnutrition. A trademark of his work was to transform complex scientific and technical issues into simple, practical messages such as his "10 easy-to-remember steps" treatment guidelines for hospital staff in treating malnutrition and its related diseases.

When Professor Waterlow returned to the UK and began his long tenure as Professor of Human Nutrition at the London School of Hygiene and Tropical Medicine (LSHTM), a long-standing and strong relationship continued with FAO. Because of his eclectic interests and knowledge, John's contributions ranged from childhood growth and diseases to nutrition requirements, with particular attention to protein, his specialty. He generously gave his time, expertise and prestige to support FAO and WHO in their nutrition programmes from the early 1970's until 2004, chairing a number of expert committees and consultations and participating in numerous seminars and meetings. Even with his retirement from the LSHTM in 1981 he continued to serve selflessly.

Not only did he serve, but the plethora of students he taught, in the United Kingdom and in Jamaica, served with him and then in his place after he did truly retire. He was seen by many, even those who had never studied formally under him, as "the professor". Once in retirement he was reluctant to fill the place of an active scientist in scientific deliberations, noting that he was no longer current with the scientific literature. However, once the deliberations began no one could quite identify those scientific areas in which he was failing. Perhaps his last scientific tour de force was the 2006 revision of the 1978 classic *Protein turnover in mammalian tissues and in the whole body*, which he did the old fashioned way relying on index cards and little on computer searches.

John Waterlow was never interested in pushing his own research or areas of interest except when it was for the welfare of the children in the developing world or, in fact, children everywhere. When the discussion became too esoteric and argumentative, he would remind all, in an even voice and with carefully chosen words, what was the main reason they were discussing these issues and "those who were the object of the discussion" should not be forgotten.

He will be remembered by all of us who had the benefit to work with him, for his extensive knowledge of nutrition, for his dedication for the cause of combating hunger and malnutrition in all its forms, and for his integrity and wisdom during the nutrition deliberations in international fora.

Acknowledgements

FAO expresses its sincere gratitude to the experts for their contributions before and during the consultation, as well as their dedication in the preparation of this report. Dr Ricardo Uauy deserves special appreciation for his skillful leadership as Chairman of the Expert Consultation and his technical guidance in the preparation of the report. We are thankful to Dr Mariette Gerber, who served as Vice-Chairperson and Drs Murray Skeaff and Petro Wolmarans, who acted as Rapporteurs. We would like to draw attention to the important contributions of the authors of the background papers for the Expert Consultation as well as those who reviewed these papers. FAO is grateful for the essential support provided by Dr Mary L'Abbe and Dr Philip Calder who served as external reviewers during the process of selecting the scientists who participated in the meeting.

Within the Secretariat, the special efforts of Dr Gina Kennedy, who compiled and reviewed draft papers and Dr Robert Weisell who prepared the background papers for publication in the *Annals of Nutrition and Metabolism*, as well as the draft report are gratefully acknowledged.

Each of these outstanding scientists is listed in the annex of this report.

Acronyms and symbols

%E	percent of energy
%E fat	percent of energy from fat
%FA	percentage fatty acid composition ("wt:wt")
AA	arachidonic acid (<i>trivial name</i>) 20:4n-6 (<i>IUPAC notation</i>)* 5z,8z,11z,14z-eicosatetraenoic acid (<i>systematic name</i>)
AD	Alzheimer's disease
AI	adequate intake (expressed as a range)
ALA	alpha linolenic acid (<i>trivial name</i>) 18:3n-3 (<i>IUPAC notation</i>)* 9z,12z,15z-octadecatrienoic acid (<i>systematic name</i>)
AMDR	acceptable macronutrient distribution range
ANR	average nutrient requirement
ARM	age-related maculopathy
BC	breast cancer
BP	blood pressure
CE	cholesterol ester
CHD	coronary heart disease
CHO	carbohydrate
ChREBP	cholesterol regulatory element binding protein
CLA	conjugated linoleic acid
CLN	conjugated linolenic acid
CNS	central nervous system
COX	cyclooxygenase
CRC	colorectal cancer
CVD	cardiovascular disease
DG	diacylglycerol
DHA	docosahexaenoic acid [cervonic acid] (<i>trivial name</i>) 22:6n-3 (<i>IUPAC notation</i>)* 4z,7z,10z,13z,16z,19z-docosahexaenoic acid (<i>systematic name</i>)
DHGLA	dihomo-gamma linolenic acid
DPA	n-6 docosapentaenoic acid
DRI	dietary reference intake
E	energy
EAR	estimated average requirement
EFA	essential fatty acid
EJCN	European Journal of Clinical Nutrition
EPA	eicosapentaenoic acid [timnodonic acid] (<i>trivial name</i>) 20:5n-3 (<i>IUPAC notation</i>)* 5z,8z,11z,14z,17z-eicosapentaenoic acid (<i>systematic name</i>)
FA	fatty acid
FAME	fatty acid methyl ester
FAO	Food and Agriculture Organization of the United Nations
FBS	food balance sheet

FDA	US Food and Drug Administration
FER	fat energy ratio
FFA	free fatty acid
FID	flame ionization detector
GC	gas-liquid chromatography
GDP	gross domestic product
GLA	gamma linolenic acid
HDL	high density lipoprotein
HDL-C	high density lipid cholesterol
HETE	hydroxyeicosatetraenoic acid
HM	human milk
HPETE	hydroperoxytetraenoic acid
IBD	inflammatory bowel disease
IDL	intermediate-density lipoproteins
IDS	individual dietary survey
IMF	intramuscular fat
IUPAC	International Union of Pure and Applied Chemistry
JAMA	Journal of the American Medical Association
L-AMDR°	lower value of acceptable macronutrient distribution range
LA	linoleic acid (<i>trivial name</i>) 18:2n-6 (<i>IUPAC notation</i>)* 9z,12z-octadecadienoic acid (<i>systematic name</i>)
LCPUFA	long-chain polyunsaturated fatty acid (>2 double bonds; >18 C atoms)
LDL	low density lipoprotein
LDL-C	low density lipoprotein cholesterol
LOX	lipooxygenase
LT	leukotriene
MCT	medium chain triglyceride
MG	monoacylglycerol
MT	metric tonne
MUFA	monounsaturated fatty acid
NIV	nutrient intake value
NOAEL	no observable adverse effect level
NRCD	nutrition-related chronic disease
OA	oleic acid
PC	prostate cancer
PG	prostaglandin
PGI	prostacyclin
PHVO	partially hydrogenated vegetable oils
PL	phospholipid
PPAR	peroxisome proliferator-activated receptor
P/S ratio	polyunsaturated fatty acid/saturate fatty acid ratio
PUFA	polyunsaturated fatty acid (2 or more double bonds)
RA	rheumatoid arthritis
RCT	randomized controlled trial
RDA	recommended dietary allowance
SDA	stearidonic acid
SFA	saturated fatty acid
SHGB	sex-hormone-binding-globulin

SL	structured lipid
SNP	single nucleotide polymorphism
SPE	sucrose polyesters
ST	structured triacylglycerols
TC	total cholesterol
TEI	total energy intake
TFA	<i>trans</i> fatty acid
TG	triacylglycerol
TLC	thin-layer chromatography
TX	thromboxane
U-AMDR ^o	upper value of acceptable macronutrient distribution range
UL ^{oo}	tolerable upper intake level
UN	United Nations
UP	upper level
VCAM	vascular cell adhesion molecule
VLDL	very-low-density lipoprotein
WHO	World Health Organization

* Note: C:Dn-#, where C=number of C atoms; D=number of double bonds and # = number of C atoms the first double bond is separated from the Methyl group; n-6 (IUPAC notation) = ω6 (Holman notation)

^o This term refers either to the upper or lower value of the AMDR range. It is very similar to the use of UCI or LCI for the upper or lower bounds of confidence intervals. Values in excess or lower than the range do not represent risk of excess or deficit respectively.

^{oo} This term was developed for instances where biochemical indicators are needed to confirm risk of adverse effects for intakes that exceed this intake level. In the case of FA, this only applies to TFA.

Contents

Acknowledgements	xiii
Acronyms and symbols	xv
CHAPTER 1: INTRODUCTION	1
Scientific Developments	1
Expert consultation process	3
References	4
CHAPTER 2: SUMMARY OF CONCLUSIONS AND DIETARY RECOMMENDATIONS ON TOTAL FAT AND FATTY ACIDS	9
Definitions	9
Levels and strength of evidence	10
Summary of total fat and fatty acid requirements for adults, infants (0-24 months) and children (2-18 years)	10
Conclusions and recommendations for total fat	13
Conclusions and recommendations for saturated fatty acids (SFA)	14
Conclusions and recommendations for monounsaturated fatty acids (MUFA)	15
Conclusions and recommendations for polyunsaturated fatty acids (PUFA)	15
Conclusions and recommendations for n-3 polyunsaturated fatty acid intake	16
Conclusions and recommendations for n-6 polyunsaturated fatty acids	16
Conclusions and recommendations for n-6 to n-3 ratio	17
Conclusions and recommendations for <i>trans</i> -fatty acid intake (TFA)	17
Considerations for food-based dietary guidelines	17
Recommendations for further research	18
Recommendations on dietary information and programme needs	19
Recommendations for nomenclature	19
References	19
CHAPTER 3: FAT AND FATTY ACID TERMINOLOGY, METHODS OF ANALYSIS AND FAT DIGESTION AND METABOLISM	21
Definition and classification of lipids	21
Fatty acid nomenclature	21
Dietary fats and fatty acids	22
Saturated fatty acids	23
Unsaturated fatty acids	23
<i>Monounsaturated fatty acids</i>	23
<i>Polyunsaturated fatty acids</i>	24
Analytical methods	25
<i>Lipidomics</i>	26
Fat digestion, absorption and transport	27
<i>Metabolism of fatty acids</i>	28
References	36

CHAPTER 4: CHOICE OF DRI, CRITERIA AND TYPES OF EVIDENCE	43
Choice of DRI	43
Overview of prior criteria and types of evidence	46
Choice of criteria	47
<i>Chronic disease outcomes</i>	47
<i>Physiological measures</i>	48
<i>Deficiency symptoms and disease</i>	49
<i>Average intakes in national survey studies</i>	49
<i>Equilibrium maintenance</i>	50
<i>Animal models</i>	50
Choosing the type of evidence	50
References	53
CHAPTER 5: FAT AND FATTY ACID REQUIREMENTS FOR ADULTS	55
Fat and fatty acid requirements for adults	55
Dietary recommendations for total fat intake	55
Dietary recommendations for saturated fatty acids (SFA)	55
Conclusions and recommended dietary requirements for MUFA	57
Conclusions and recommended dietary requirements for PUFA	58
Conclusions and recommended dietary requirements for n-6 polyunsaturated fatty acids	58
Conclusions and recommended dietary requirements for n-3 polyunsaturated fatty acid intake	59
Conclusions and recommended dietary requirements for n-6 to n-3 ratio	59
Conclusions and recommended dietary requirements for <i>trans</i> -fatty acid intake	60
Considerations for food-based dietary guidelines	60
References	60
CHAPTER 6: FAT AND FATTY ACID REQUIREMENTS AND RECOMMENDATIONS FOR INFANTS OF 0-2 YEARS AND CHILDREN OF 2-18 YEARS	63
Background on the role of fats and fatty acids in infant and child nutrition	63
Background on essential fatty acid deficiency	64
Background on energy supply from fat and early growth	65
Recommendations for total fat intake of infants 0-24 months	67
Recommendations for fatty acid intake of infants 0-24 months	67
Comparison with the 1994 recommendations and the proposed values	67
Recommendations for total fat intake for children 2-18 years	69
Recommendations for fatty acid intake for children 2-18 years	69
Human milk as a model to define acceptable intakes (AI) for fats and fatty acids in early life for normal infants (0 to 2 years)	69
Recommendations for dietary intakes of specific essential fatty acids for infants and children	70
Recommendations for dietary intakes of special groups of infants and children	70
<i>Preterm infants</i>	70
Safety issues when considering food sources of fats intended for use by children	71
Storage, packaging and distribution	71
Research needs for children 2-18 years	72
References	72

CHAPTER 7: FAT AND FATTY ACID DURING PREGNANCY AND LACTATION	77
Dietary fat intake during pregnancy and lactation	77
References	85
CHAPTER 8: FAT AND FATTY ACID INTAKE AND INFLAMMATORY AND IMMUNE RESPONSE	91
Immunity	91
<i>Innate immunity</i>	91
<i>Acquired (or adaptive) immunity</i>	91
Fatty acids and inflammation	92
<i>Introduction</i>	92
<i>Lipid mediators in inflammation</i>	92
Human studies on dietary fats and inflammation: n-3 PUFA	94
<i>Introduction</i>	94
<i>Asthma</i>	94
<i>Inflammatory bowel disease (IBD)</i>	94
Rheumatoid arthritis (RA)	95
<i>Role of dietary ALA in modulating inflammation</i>	95
<i>Human studies on dietary fats and inflammation: other fatty acids</i>	96
Conclusions	96
Recommendations	96
References	96
CHAPTER 9: TOTAL FAT, FATTY ACID INTAKE AND CANCERS	99
Total fat and its relationship with various types of cancer	100
<i>Colorectal cancer</i>	100
<i>Breast cancer</i>	100
<i>Endometrial cancer</i>	101
<i>Ovarian cancer</i>	101
Animal fat	101
Saturated fat	101
Monounsaturated fatty acid	101
Essential fatty acids: n-6 FA: linoleic acid and n-3 FA: α-linolenic acid	102
n-3 LCPUFA	102
<i>Colorectal cancer</i>	102
<i>Prostate cancer</i>	103
<i>Breast cancer</i>	103
n-6 PUFA/n-3 PUFA	103
Trans FA	104
Discussion of nutritional and genetic aspects	104
Recommendations	105
<i>Total fat</i>	105
<i>SFA</i>	106
<i>MUFA</i>	106
<i>Essential fatty acids, LA and ALA</i>	106
EPA+DHA	106
TRANS FA	106
Food and dietary-base recommendations	106
<i>Fish</i>	106
<i>Food patterns</i>	106

Recommendations for future research	106
References	106
CHAPTER 10: FAT AND FATTY ACID INTAKE AND METABOLIC EFFECTS IN THE HUMAN BODY	113
Summary	113
Fasting plasma lipids and lipoproteins	114
Postprandial lipids	116
Insulin-sensitivity	116
Indices of oxidative stress	116
Inflammatory markers	117
Pro-coagulant and fibrinolytic activity	117
Blood pressure and arterial stiffness	117
Endothelial function	118
Dietary interactions with genotype	118
References	119
CHAPTER 11: DIETARY FAT AND CORONARY HEART DISEASE	129
References	131
CHAPTER 12: FAT INTAKE AND CNS FUNCTIONING: AGEING AND DISEASE	133
Assumptions and limitations	133
<i>Brain disorders and mental ill-health</i>	133
Summary of requirements	134
<i>Daily requirement of adult brain for PUFA</i>	134
<i>n-3 LCPUFA and depression and bipolar disorder</i>	135
<i>Cognitive decline</i>	135
<i>Aggression, hostility and antisocial behaviour</i>	135
<i>Age-related maculopathy (ARM)</i>	135
<i>Alzheimer's disease</i>	135
<i>Schizophrenia</i>	136
<i>Huntington's disease</i>	136
Conclusions for Adults Central Nervous System (CNS) function	136
Remarks	136
References	137
CHAPTER 13: GLOBAL TRENDS IN PRODUCTION, INTAKE AND FOOD COMPOSITION	139
Production of vegetable oils and animal source foods	139
Production of vegetable oils	139
Production of animal source fat	140
Production of fish oil and fish	141
Fat supply and intake data	141
<i>Energy and fat supply data from food balance sheets</i>	141
Individual dietary surveys	142
Fatty acid composition of food	143
<i>Vegetable oils</i>	143
<i>Margarine</i>	143
<i>Nuts</i>	144

<i>Dairy products</i>	144
<i>Livestock</i>	144
<i>Designer eggs</i>	145
<i>Fish</i>	145
<i>Fast foods</i>	146
Conclusions	147
References	147
CHAPTER 14: PROCESSING, MANUFACTURING, USES AND LABELLING OF FATS IN THE FOOD SUPPLY	153
Manipulation of physiochemical properties of oils and fats	153
<i>Hydrogenation</i>	153
<i>Interesterification</i>	153
<i>Fractionation</i>	153
Margarine - processing	154
Structured lipids	154
<i>Fat replacers</i>	154
<i>Fat Substitutes</i>	154
Other approaches (multiple emulsions)	155
<i>Reduced trans fatty acids (TFA)</i>	155
<i>Manufacture of trans-free lipids</i>	155
<i>Processing losses</i>	155
<i>Frying oils</i>	156
Fat-carbohydrate interactions in food systems	156
<i>Starch-lipid interactions</i>	156
<i>Role of fats and oils in infant feeding</i>	157
<i>Energy density and viscosity of foods</i>	157
Labelling	157
General conclusions	158
References	158
ANNEX: LIST OF PARTICIPANTS AND CONTRIBUTORS	161

LIST OF TABLES

TABLE 2.1:	
Recommended dietary intakes for total fat and fatty acid intake: Adults	11
TABLE 2.2:	
Recommended dietary intakes for total fat and fatty acid intake: Infants (0-24 months) and children (2-18 years)	12
TABLE 3.1	
Lipid categories and typical examples	21
TABLE 3.2	
Common saturated fatty acids in food fats and oils	23
TABLE 3.3	
Some common <i>cis</i>-monounsaturated fatty acids in fats and oils	24
TABLE 3.4	
Nutritionally important n-6 PUFA	25
TABLE 3.5	
Nutritionally important n-3 PUFA	25
TABLE 3.6	
Physiological actions of eicosanoids derived from arachidonic acid	35
TABLE 3.7	
Physiological actions of eicosanoids derived from eicosapentaenoic acid (EPA) and docosanoids derived from docosahexaenoic acid (DHA)	36
TABLE 4.1	
Summarized overview of stated criteria and evidence used to determine dietary guidelines for fatty acids	44
TABLE 4.2	
Types of dietary reference intakes (DRIs)	46
TABLE 4.3	
WHO/FAO criteria used to describe the strength of evidence relating diet and NCD outcomes	51
TABLE 4.4	
National health and medical research council levels of evidence	53
TABLE 5.1	
Recommended dietary intakes for total fat and fatty acid intake for adults	56
TABLE 6.1	
Recommended dietary intakes for total fat and fatty acid: infants (0-24 months) and children (2-18 years)	66
TABLE 7.1	
Meta-analyses and systematic reviews of LCPUFA supplementation with pregnancy outcomes	79
TABLE 7.2	
Recommended NIV in pregnancy and lactation	81
TABLE 7.3	
RCT of n-3 LCPUFA in pregnancy and lactation that report functional outcomes other than birth outcomes (gestational length, birth weight, birth length)	82
TABLE 8.1	
Selected cytokines and their activities	93
TABLE 9.1	
Summary of strength of evidence: Fat, fatty acids and cancers	105
TABLE 9.2	

Summary of strength of evidence: Food, diet and cancers	105
TABLE 10.1	
Change in serum lipids (mmol/L with 95% CI) predicted from replacing 1% energy by individual fatty acids for carbohydrate based on meta-analysis and changes from increasing intake of dietary cholesterol by 100mg	113
TABLE 11.1	
Summary judgement of the epidemiological evidence for dietary fat and coronary heart disease	131
TABLE 12.1	
Current level of evidence for long-chain n-3 fatty acids in relation to CNS functioning	136
TABLE 13.1	
Global trends in the production (domestic supply) of vegetable oils in 1995-1997, 1998-2000 and 2001-2003	140
TABLE 13.2	
Vegetable oils produced in different regions of the world (mean 2001-2003)	140
TABLE 13.3	
Total fat, EPA and DHA content of different fish species	146
TABLE 14.1	
Methods for manufacturing trans-free/low-trans fatty acids products	156
TABLE 14.2	
Effects of added oil on energy, protein and iron density of maize	157
TABLE 14.3	
Dietary recommendations for trans fatty acids	158

LIST OF FIGURES

FIGURE 3.1	
Metabolic pathways for the conversion of dietary linoleic and α -linolenic acids to their longchain polyunsaturated fatty acids	30
FIGURE 3.2	
Eicosanoid formation from arachidonic acid (AA) via the cyclooxygenase (COX) and lipoxygenase 5-LOX) pathways. HPETE = hydroxyperoxyeicosatetraenoic acid; HETE = hydroxyeicosatetraenoic acid; LT = leukotriene; TX, = thromboxanes; PG = prostaglandins	33
FIGURE 3.3	
Eicosanoid formation from eicosapentaenoic acid (EPA) via the cyclooxygenase (COX) and lipoxygenase (5-LOX) pathways. HPETE, hydroxyperoxy-eicosapentaenoic acid; HETE = hydroxyeicosatetraenoic acid; LT = leukotriene; TX = thromboxanes; PG = prostaglandins	33
FIGURE 3.4	
Metabolic pathways for the conversion of eicosapentaenoic (EPA) and docosahexaenoic (DHA) to resolvins and protectins. LOX = Lipoxygenase. COX = Cyclooxygenase	34
FIGURE 4.1	
Dietary reference intake distribution	47
FIGURE 4.2	
Ranking of validity of types of evidence for setting dietary fatty acid requirements	51
FIGURE 7.1	
Regression analysis of breast milk DHA (B) concentration vs DHA intake (I). $B=(0.72 \times I)+0.20$ ($r^2 = 0.998$)	78
FIGURE 7.2	
Dose response for prevalence of children in the lowest quartile for verbal IQ at age 8 based on maternal seafood consumption during pregnancy. At maternal seafood consumption corresponding to LCPUFA intake of 0.10 %E (about 300 mg/day), the reduction in risk for low verbal IQ drops from 31% (no seafood consumption) to about 20.5%. With 5-fold more seafood consumption, risk drops to about 15.5%	78
FIGURE 8.1	
Production pathways of mediators derived from LCPUFA	95
FIGURE 13.1	
Total production (capture and aquaculture) of fish between 1950 and 2006 (fish included in total production: salmon, trout, smelt, herring, sardine, anchovy, tuna, bonito and billfish)	142

Chapter 1: Introduction

The Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO), in their roles as technical agencies of the United Nations (UN), are charged with providing science-based guidance on food and nutrition to national governments and the international community. The process used to do this involves periodic and systematic reviews of scientific evidence, which often culminates with the convening of joint expert consultations to review the state of scientific knowledge, deliberate on the issues and translate this knowledge into a definition of requirements and corresponding nutrient-based recommendations. The overall goal of these recommendations is to support health and nutritional well-being of individuals and populations. The topics covered during the recent past include energy, protein and amino acids, fats and oils, most of the vitamins and minerals and carbohydrates, with the objective of providing guidance on nutritional requirements and recommended dietary intakes.

The Joint FAO/WHO Expert Consultation on Fats and Fatty Acids in Human Nutrition (hereafter Expert Consultation) was the most recent expert meeting convened, and was held in Geneva from 10 to 14 November 2008. The Expert Consultation was the third to be held on the subject of fats in human nutrition, the first expert consultation on this topic being held in 1977 (FAO, 1978) and the second in 1993 (FAO, 1994).

The timeliness of this Expert Consultation is also tied to the clear recognition of the increasing global burden of nutrition-related chronic disease. Recent work of FAO and WHO in connection with this includes the 2002 Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases (WHO, 2003), the 2001 Expert Consultation on Human Energy Requirements (FAO, 2004) and its companion 2002 Expert Consultation on Protein and Amino Acid Requirements in Human Nutrition (WHO, 2007), one 2002 Technical Workshop on Food Energy – Methods of Analysis and Conversion Factors (FAO, 2003), and several Scientific Updates; one by FAO/WHO in 2006 on Carbohydrates in Human Nutrition (Nishida *et al.*, 2007) and another by WHO on *Trans* Fatty Acids (Nishida and Uauy, 2009). These integrated efforts provide, to varying degrees, the scientific basis that guides strategies, programmes and projects of FAO and WHO and their Member Countries.

During the past fifteen years, the changes in diets and lifestyles resulting from industrialization, urbanization, economic development and market globalization have increased rapidly and particularly in the developing countries where major socio-economic changes are occurring. Whereas general improvement in the standard of living has been observed, this has often been accompanied by unhealthy dietary patterns and insufficient physical activity to maintain an optimal energy balance and a healthy weight. The net result has been increased prevalence of diet-related chronic diseases in all socio-economic groups and which now represent the main cause of deaths and disability worldwide.

SCIENTIFIC DEVELOPMENTS

There have been a number of major developments in the field of fats and fatty acids in human nutrition during the past fifteen years, with the resulting need for an update since the 1994 publication and recommendations. These developments are elaborated