

MILK *and*  
dairy products  
*in* human nutrition



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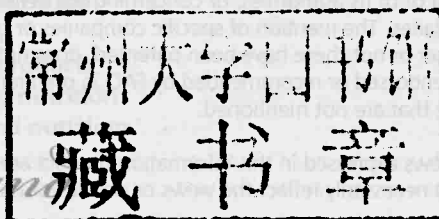
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# Preface

Billions of people around the world consume milk and dairy products every day. Not only are milk and dairy products a vital source of nutrition for these people, they also present livelihoods opportunities for farmers, processors, shopkeepers and other stakeholders in the dairy value chain. But to achieve this, consumers, industry and governments need up-to-date information on how milk and dairy products can contribute to human nutrition and how dairying and dairy-industry development can best contribute to increasing food security and alleviating poverty.

This publication is unique in drawing together this information on nutrition, dairying and dairy-industry development from a wide range of sources and exploring the linkages among them. It is the result of collaboration between the Agriculture and Consumer Protection and the Economic and Social Development Departments of the Food and Agriculture Organization of the United Nations (FAO). The Nutrition Division of FAO's Economic and Social Development Department and the Rural Infrastructure and Agro-Industries Division of the Agriculture and Consumer Protection Department jointly led and coordinated the planning, preparation and publication process.

In producing this publication our aims were to:

- provide an in-depth look at selected topics of concern regarding dairy and nutrition, from milk production to consumption;
- provide a balanced and unbiased scientific overview of the impact of milk and dairy consumption on human nutrition and health in developed and developing countries; and
- give insights on dairy's potential to improve the diets of poor and undernourished people and implications for future actions by diverse stakeholders.

Many experts and scientists from around the world, from disciplines such as nutrition and food science, food safety, dairy-industry development, economics and agriculture, contributed to writing and reviewing the information and scientific knowledge presented in this publication. Each chapter has been peer reviewed by at least four independent experts to ensure that the information provided is verifiable and of good quality.

The technical editorial team thanks all who gave so generously of their expertise, time and energy.

Ellen Muehlhoff  
Anthony Bennett  
Deirdre McMahon

## Foreword

FAO is pleased to present its new book on *Milk and Dairy Products in Human Nutrition*.

This book comes at an opportune time of renewed interest in agriculture and sustainable food-based solutions as a key strategy for improving diets and bringing greater nutritional benefits to poor and malnourished people.

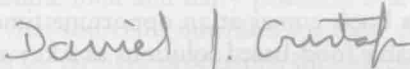
In 1959, the Food and Agriculture Organization of the United Nations (FAO) produced *Milk and Milk Products in Human Nutrition*, a seminal treatise on the topic. In response to popular demand, a revised second edition was produced in 1972. Half a century after the first publication, in 2009, it was time to revisit the role of milk and dairy products in human nutrition and development.

With rising incomes and increased production, milk and dairy produce have become an important part of the diet in some parts of the world where little or no milk was consumed in the 1970s. Consumption of milk and dairy products is growing fastest in Asia and the Latin America and Caribbean region. India has recently become the world's largest milk producer, yet per capita consumption levels there are still low. Globally, too many poor people are still not able to afford a better diet and greater efforts, including agricultural growth, diversification and public investment, are needed to ensure that poor and undernourished people can acquire food that is adequate in quantity (dietary energy) and in quality (diversity, nutrient content and food safety).

FAO, in pursuing its mission of eradicating hunger and improving food security and nutrition for all, seeks to improve awareness among consumers and member governments of the importance of a balanced, healthy and sustainable diet. Our role as a global knowledge centre is to provide sound advice to member countries on the role and value of various foods from production to consumption and their role in human nutrition and health.

The publication comprises nine chapters that can either be read from start to finish for a full appreciation of the connections between dairy and human nutrition, or by topic and area of interest. The book presents information on the nutritional value of milk and dairy products and evaluates current scientific knowledge on the benefits and risks of consuming milk and dairy products in the context of global changes in diets. It highlights positive effects that connect dairy agriculture, nutrition and health at the local, national and global levels, and identifies gaps in current knowledge in these areas. It reviews global trends in milk production and consumption, discusses challenges for sustainable and inclusive dairy-industry development and food safety, reviews programmatic experiences and lessons learned about food-based solutions to problems of malnutrition and provides concrete options for governments, international organizations and the private sector. Each chapter provides a comprehensive set of references allowing the reader to probe the topics further.

The publication serves a variety of audiences, from academia to research, policy-makers and planners, the private sector and the consumer. I hope that the information presented will encourage dialogue and action within and between the sectors to achieve our common goals of reducing poverty, strengthening livelihoods and improving human nutrition and health on a sustainable basis. This way we will be taking another step in the direction of meeting the Zero Hunger Challenge earmarked by the UN Secretary-General at the Rio+20 Sustainable Development Summit in June 2012.



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EPA European Environment Agency

EPIC European Programme Intervention Unit Centre and Nutrition

EU European Union

FAO Food and Agriculture Organization

FDA Food and Drug Administration (United States)

IFAD International Fund for Agricultural Development

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# Abbreviations and acronyms

ADI	acceptable daily intake
AGEs	advanced glycation end products
ALA	alpha-linolenic acid
APHCA	Animal Production and Health Commission for Asia and the Pacific
ASF	animal-source food
BMD	bone mineral density
BMI	body mass index
BPA	bisphenol A
bTB	bovine tuberculosis
CFC	Common Fund for Commodities
CHD	coronary heart disease
CI	confidence interval
CLA	conjugated linoleic acid
CMA	cow-milk allergy
CSB	corn-soy blend
CUP	Continuous Update Project
CVD	cardiovascular disease
DASH	Dietary Approaches to Stop Hypertension
DDP	dairy development project
DGDP	Dairy Goat Development Project
DHA	docosahexaenoic acid
DIDP	dairy industry development programme
DRACMA	Diagnosis and Rationale for Action against Cow's Milk Allergy
EADD	East Africa Dairy Development project
EARO	Ethiopian Agricultural Research Organization
EC	European Commission
EFSA	European Food Safety Authority
EPA	eicosapentaenoic acid
EPIC	European Prospective Investigation into Cancer and Nutrition
EU	European Union
FA	fatty acid
FDA	Food and Drug Administration (United States)
FDM	fat in dry matter

FPCM	fat and protein-corrected milk
GDP	gross domestic product
GHG	greenhouse gas
GI	glycaemic index
GMP	good manufacturing practices
GVP	good veterinary practices
HAZ	height-for-age Z-score
HDL	high-density lipoprotein
HFP	Homestead Food Production programme (Helen Keller International)
HIV	human immunodeficiency virus
HKI	Helen Keller International
HR	hazard ratio
IDF	International Dairy Federation
IgE	immunoglobulin E
IFPRI	International Food Policy Research Institute
IGF-1	insulin-like growth factor-1
IHD	ischaemic heart disease
ILRI	International Livestock Research Institute
IPCC	Intergovernmental Panel on Climate Change
iTFA	industrial <i>trans</i> fatty acid
IU	international units
JECFA	Joint FAO/WHO Expert Committee on Food Additives
KCC	Kenya Cooperative Creameries
LAB	lactic acid bacteria
LAC	Latin America and the Caribbean
LA	linoleic acid
LC-PUFA	long-chain polyunsaturated fatty acids
LDL	low-density lipoprotein
LME	liquid milk equivalent
LNP	lactase non-persistence
LNS	lipid-based nutrient supplement
LP	lactoperoxidase system
MetS	metabolic syndrome
MDG	Millennium Development Goal
MFFB	percentage moisture on a fat-free basis
MRL	maximum residue limit
MUAC	mid-upper arm circumference
MUFA	monounsaturated fatty acid
NCDs	non-communicable diseases

NGO	non-governmental organization
NHANES	National Health and Nutrition Examination Survey (United States)
NRA	nominal rate of assistance
OECD	Organisation for Economic Co-operation and Development
PBM	peak bone mass
PCBs	polychlorinated biphenyls
PDCAAS	protein-digestibility-corrected amino acid score
PHVOs	partially-hydrogenated vegetable oils
PUFA	polyunsaturated fatty acid
Rbst	recombinant bovine somatotropin
RCT	randomized controlled trial
RDA	recommended daily allowance
REACH	Renewed Efforts Against Child Hunger
RNI	recommended nutrient intake
RR	relative risk
rTFA	ruminant <i>trans</i> fatty acid
RUSF	ready-to-use supplemental food
RUTF	ready-to-use therapeutic food
SD	standard deviation
SES	socio-economic status
SFA	saturated fatty acid
STEC	Shiga toxin-producing <i>E. coli</i>
SUN	Scaling-up Nutrition
T2DM	type 2 diabetes mellitus
TB	tuberculosis
TFA	<i>trans</i> fatty acids
UHT	ultra high temperature
UK	United Kingdom
UNEP	United Nations Environment Programme
UNICEF	United Nations Children's Fund
UNSCN	United Nations Standing Committee on Nutrition
USA	United States of America
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
UV	ultraviolet
WCRF	World Cancer Research Fund
WFP	World Food Programme
WHZ	weight-for-height Z-score
WHO	World Health Organization

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