

## BOOK REVIEWS

and stringent, and are more or less similar in all countries. Vehement and persistent anti-GE activism has curtailed wider adoption of these crops globally. Long before agri-biotech products were developed, scientists (and not activists) were conscious of the potential risks of the recombinant technology. Biosecurity guidelines have evolved and incrementally improved over time. Indeed, transgenic foods are the most stringently tested food products in human history. Over the years, doubts have been repeatedly raised on the safety of GE crops, but none has been substantiated. The chapter argues that unreasonable demands (e.g. on the number and duration of safety tests) and misrepresented provisions of regulatory protocols (e.g. Convention on Biological Diversity, Cartagena Protocol, the Precautionary Principle) have added to the regulatory burden.

Two chapters on the status of crop biotechnology in China (chapter 3) and Ghana (chapter 13) present contrasting pictures. China was one of the earliest countries to conduct R&D in agri-biotechnology with a robust regulatory system for GE crops. Ghana, on the other hand, is yet to commercialize a GE crop (transgenic high-protein sweet potato is under confined field trials). The earliest commercial success in China was Monsanto's *Bt*-cotton technology in the 1990s, but now home-grown technologies dominate. Papaya, sweet pepper, tomato and poplar are the other crops that have been deregulated with traits including insect/virus resistance and longer shelf-life. Technology for deployment of 'golden' rice rich in  $\beta$ -carotene was ready, but strong opposition by activists put a halt to the efforts.

Insect resistance and *Bt*-cotton figure prominently in chapters 4 and 5. As pointed out in these chapters, *Bt*-cotton technology came at a time when farmers had no viable solution to the management of bollworms on cotton. The all-round gains of this technology are unparalleled in the history of crop protection and production. It has reduced insecticide usage and increased the socio-economic status of small, marginal and resource-poor farmers in several developing countries. Poor compliance on the recommended non-*Bt* refuge crop is a matter of grave concern as it will surely lead to pest resistance if nothing else is done. Chapter 5 strongly recommends developing alternate strategies of refuge

delivery with assured farmer compliance. Five chapters 6, 7 and 9–11 are devoted to resistance to pathogens such as viruses, fungi and bacteria. Chapter 6 analyses the status of GE crops in Asia and Latin America and chapter 7 examines the situation in Africa. The other three chapters 9–11 are detailed technical reviews on research approaches such as pathogen-derived, non-pathogen-derived and host plant-derived resistance for enhancing viral resistance in crop plants.

Chapter 8 is an appraisal of the global status of herbicide-resistant GE crops. Transgenic canola, cotton, maize and soybean are already commercialized in some of the Asian, African and Latin American countries. A few Latin American countries have also deregulated cotton and maize with combined resistance to herbicides and insects. Chapter 12 outlines the strategies for nutritional enhancement in staple food crops and concludes that while biofortification of crops is technically feasible through genetic engineering without compromising on agronomic performance, the major challenge is public acceptance.

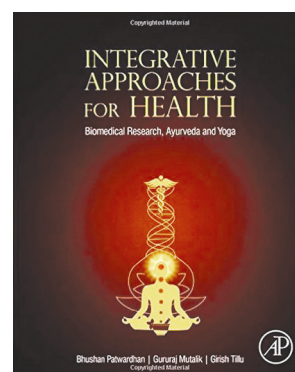
At the end of the day, have GE crops been socio-economically beneficial across the world? Interestingly, a recent meta-analysis published while this book was in press (Klümper, W. and Quaim, M., *PLoS One*, 2014, 9(11), e111629; doi: 10.1371/journal.pone.0111629) summarizes the findings of 147 original studies published between 1995 and March 2014, to provide robust evidence that GE technology applied to soybean, maize and cotton has reduced chemical pesticide use by 37%, increased crop yields by 22% and enhanced farmer profits by 68%. The analysis also concluded that (a) yield gains and pesticide reductions are larger for insect-resistant crops than for herbicide-tolerant crops, and (b) yield and profit gains are higher in developing countries than in developed countries. It is important to note that this analysis was exclusively publicly funded (and not industry-sponsored).

The editors state in the Preface that the book is designed to address politicians, policymakers, the bureaucracy, judiciary, young scientists, students, teachers, general public and, especially, the media. That is too diverse a constituency and impossible to reach through a single volume such as this. The book has a pleasing get-up, but careful proofreading could have avoided several irksome

glitches. Some examples: (a) the first author's first name (Basavaprabhu) is misspelt in the title page of chapter 12 (p. 341); (b) the text on p. 5, line 19 cites Ahluwalia, 1978, but under references on p. 30 it is Montek A. S., 1978; (c) 'Monsanto exits', 2001 is cited on p. 139, line 10, but is missing under references; (d) high, 2004 cited on p. 139, line 19 is actually High *et al.*, 2004. The five half tones included in the book could have been of a better quality. The labels on the photographs and legend in figure 1 (p. 225) are confusing. These minor blemishes apart, the chapters have been written by experts in the field. The authors and editors must be complimented for painstakingly putting together the information in one place. The book certainly succeeds in putting forth the scientific viewpoint on several contentious issues relating to the development and deployment of transgenic crops, and deserves to be read by all those interested in this area. Whether it will fulfil the hope to 'promote informed decisions by all stakeholders' will be interesting to see.

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**Integrative Approaches for Health: Biomedical Research, Ayurveda and Yoga.** Bhushan Patwardhan, Gururaj Mutalik and Girish Tillu. Academic Press, Elsevier. 2015. 382 pp. Price: US\$ 84.96.

The twelve chapters of the book titled *Integrative Approaches for Health: Biomedical Research, Ayurveda and Yoga* is an extremely timely publication. The

timeliness of the publication is important because it addresses a writing on the wall, in respect of healthcare in the 21st century. This writing spells integrative healthcare. This new direction has been evident for more than two decades and is reflected in the pluralistic health-seeking behaviour of millions of ordinary citizens all over the world. Lay persons already perceive that no single system of healthcare has the best solutions for all their health needs. The problem is that citizens have thus far not received adequate support from policy, research, education and health services so that they can make informed choices about integrative healthcare solutions.

The book is designed for academia (teachers and students), practitioners and researchers of Ayurveda, Yoga, medicine and public health. As the title rightly mentions, the book discusses various aspects of health and does not restrict itself to curative medicine. It covers an incredible breadth and depth of issues. The authors at the very outset acknowledge the impressive advances in genomics, proteomics, metabolomics, molecular medicine, computational biology, informatics alongside development of sophisticated diagnostic and surgical tools, new biocompatible materials and drugs. However, they make out the case for integrative healthcare based on an analysis of unresolved problems and challenges. The book is particularly focused on integration in the Asian context, because of richness of diverse health traditions indigenous to Asia like Ayurveda, Yoga, TCM, Kampo, Traditional Korean Medicine and Sowa-Rigpa. The book contains chapters with integrative perspectives on life style and behaviour, food and diet, health supplements, drug discovery, rejuvenation and personalized healthcare. These components are described in the background of state-of-the-art research developments in modern medicine, and with suggestions of potential contributions from Ayurveda and Yoga.

The second chapter takes a close look at evolution of medicine in the east, as well as in the west. The authors reflect on the need to bring about confluence of western analytical mind and eastern holistic thinking. A comprehensive review of eastern medical traditions from China, Japan, Korea and Tibet helps the reader to identify the interconnections amongst these Asian systems of healing. The evolution of Ayurveda and modern medicine

is sketched over a long timeline of events, noting contributions by many scientists and physicians. The authors conclude that rationalism, reductionism and inductive logic have shaped modern medicine, but its interaction with systemic and intuitive traditional knowledge will lead to a humane and sustainable healthcare.

The third chapter is a critique of contemporary healthcare. It points out the limitations of modern concepts of health which erroneously are equated with medicine and disease management. It informs the reader about the evolution of the classification of diseases, the changes it has undergone and its current state of flux. It explores the idea of expanding the concept of health and disease based on holistic knowledge of health that is embodied in traditional health sciences.

The chapter on 'Evidence based medicine (EBM)' is incisive and comprehensive. It reviews the nature and levels of evidence. It pleads for an innovative and balanced strategy for EBM in the context of integrative healthcare. The fifth chapter on systems biology is extremely well informed. The authors while they point out that the existing methodologies in systems biology require refinement, development and the integration of new technologies such as next-generation sequencing, DNA methylome, miRNA and metabolomics, they simultaneously recommend integration of systems biology with the systems approaches in Ayurveda, because they visualize that this integration may add value and insights that may help analyse the gigantic data sets generated by systems biology in holistic framework.

The chapter on lifestyle and behaviour starts with a quote from Voltaire 'Doctors give drugs of which they know little, into bodies, of which they know less, for diseases, of which they know nothing at all'. The authors observe that most of the times, the benefits of lifestyle and behaviour get ignored due to the perceived promise of potent drugs. The authors introduce concepts of *Swasthavritta* in the context of behavioural and lifestyle medicine. The chapter further describes spiritual aspects of health and teaching of Ayurveda and Yoga described as *Sadvritta* which expands the canvass of lifestyle interventions. The argument about lifestyle modification as a solution for medicalization of society is well placed in this chapter.

The authors dedicate two chapters to discuss food and health supplements. The chapter on food and diet portrays the evolution of concepts of nutrition. Ayurveda concepts of customized nutrition based on season and constitution of an individual are discussed. The authors also discuss the physiological effects of fasting. The newer concepts like gut microflora, pre- and probiotics, and nutrigenomics are discussed in the background of Ayurveda concepts of nutrition.

The chapter on health supplements discusses nutraceuticals, functional foods, vitamins, minerals, dietary and herbal supplements, and their effects. This chapter extensively reviews available evidence and recommendations of professional organizations and concludes that natural food consumption is better than health supplements.

The authors make an important recommendation for shifting drug research strategy from a single targeted new chemical entity or a magic bullet linear mind-set to multiple-target, synergistic formulation discovery approach. The upcoming network pharmacology framework is advocated as it harnesses systems biology concepts and bioinformatics. The case studies based on authors' own research show the potential of traditional medicine inspired natural product discovery approaches. The authors expect that 'integration of wisdom, ideas and technology will help modern science to rediscover drug discovery' is perhaps pertinent to end the present impasse in drug discovery.

The chapter on 'Longevity, rejuvenation and rasayana' describes the status of ageing world, research on *Rasayana* and potential applications for improvement of lifespan, tissue-specific regeneration and overall quality of Life. The authors discuss how Ayurveda and Yoga can contribute for addressing challenges of ageing.

In a chapter on 'Personalized approaches for health', the authors review modern efforts to classify humans into genotypes. They point out that Ayurvedic view of *Prakriti* has striking similarity with the Hippocratic and Galen's approach, somatotypes, Chinese, Korean and Unani approaches. Although genomics is helping to understand individual variations, the challenge is to understand the relations and interactions between genes and environmental triggers of

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variations. The authors observe that modern medicine which is now considering individual variations, stratification and systematic sub-grouping, has much to learn from Ayurveda concepts of *Prakriti* and disease sub-typing. The authors' contribution to AyuGenomics is presented as an interesting case study, which shows a journey of several studies that explain genetic basis of *Prakriti*. They have also reviewed present advances in omics including pharmacogenomics, metabolomics, epigenetics, etc., and suggested Ayurveda-inspired research approaches and applications for the future.

The global review of health is discussed in the first chapter 'Advocacy for integration' and the concluding chapter 'Integrative approaches for the future'. This review covers various ongoing efforts in India, Europe, United States and Australia. The Indian scenario is encouraging where integrative models of

Yoga and Ayurveda are being developed. However the ills of unethical cross practice of medicine seem to be distorting the discourse on integrative medicine. The authors suggest that there are many levels of integration required starting from epistemology to the strategy for field level application.

Interestingly, the three authors represent three generations and thus bring a unique blend of domain expertise in each of the three components of this book *Biomedical Research, Ayurveda and Yoga*. The authors recognize that integrative healthcare is an evolving field and point out that it may not be desirable to develop a uniform model. They visualize crystallization of different dynamic models in different countries and cultures.

The book is an important step in the direction of informed integrative healthcare as it outlines knowledge and per-

spectives that can help shape strategies for disruptive innovation and leap frogging into 21st century healthcare. The book obliquely suggests that India with its competence in modern biology, Ayurveda and Yoga can be a global leader in this emerging field. It defines a path for future of healthcare by empowering peoples' health with all available wisdom and technological advances instead of working in silos. This becomes a good resource for all inquisitive readers who are interested in integrative medicine and health.

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