Chapter 30
Nutrition, Food and Diet: Recapitulation, Conclusions and Suggestions

Suresh I. S. Rattan and Gurcharan Kaur

Abstract Here we recapitulate the main themes of the issues related to nutrition, food and diet discussed in the twenty-nine chapters in this book. The insights from various contributions have been extracted to conceptualize how nutritional components are not only the source of building blocks and energy for the body, but also serve numerous critical functions in maintaining health. This wealth of information can be useful for making recommendations and suggestions for food for health and longevity, especially in old age. A central message derived from this collection of articles is that optimizing our nutrition by making the right choice of food, and aligning our eating behaviors with our bio-social rhythms, are the most effective general strategies to maintain, recover and enhance individual- and public-health.

Keywords Nutrition · Longevity · Healthy ageing · Macro- and micronutrients · Diet and culture · Nutritional interventions

30.1 Introduction

In this volume of the bookseries "Healthy Ageing and Longevity", we have succeeded in bringing together a diversified group of researchers and academicians reviewing the published literature and presenting their personal views about nutritional components, foods, dietary patterns, and nutrition- and diet-based interventions for health and longevity.

It is worth repeating from our preface to this volume that nutrition, food and diet are the terms often used casually and uncritically as overlapping ones. However, while "nutrition" generally refers to the macro- and micro-nutrients essential for health and survival, nutrition is normally obtained from animal- or plant-based foods. We do not eat nutrition, we eat food, without always being aware or conscious of the nutritious

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value of the food. Moreover, these nutritional values may or may not match our bodily requirements which depend upon various factors, such as age, general health status, physiological demands and accessibility. Even more importantly, there are crucial socio-cultural dimensions which give shape to our taste, preferences and taboos towards food (Samaddar et al. 2020). Furthermore, the three commonly identified meals of the day – breakfast, lunch and dinner – are as varied globally as different populations, societies and cultures. And above all of this lurks in the background the evolutionary history of *Homo sapiens* from being hunter-gatherers to becoming agriculturists (Finch 2010), and to the present state of becoming the consumers of highly processed food products with overeating behaviors wherever food is available in abundance.

In this concluding chapter, we try to recapitulate the main messages which can be derived from various chapters in this book (Table 30.1), and how that information can be useful for making recommendations and suggestions for practical use and for future research. Perhaps the central carry home message is obvious that optimizing our nutrition by making the "right" choice of food and aligning our eating behaviors with our bio-social rhythms are the most effective general strategies to maintain, recover and even enhance individual- and public-health.

30.2 Nutrition

Proteins, carbohydrates and lipids are the three essential nutritional components which provide us the basic material for building our biological structures and for producing the energy required for all physiological and biochemical processes. Additionally, minerals and micronutrients, including vitamins, facilitate the optimal utilisation of the primary nutritional components by catalyzing numerous biochemical processes, by increasing their bioavailability and absorption, and by balancing the microbiome crucial for maintaining health *(see Chapters 1 to 5).* Another category of nutrients, termed nutritional hormetins, are various compounds in the food, which by virtue of their toxic nature, induce and stimulate body's intrinsic repair and maintenance systems. This apparently paradoxic effects of toxic compounds in the food as health-beneficial nutritional hormetins is in line with the basic understanding of the biological mechanisms of health and survival through adaptive responses and hormesis (Rattan and Kyriazis 2019) *(see chapter 6).* Furthermore, it is in this context that we need to understand and appreciate the evolutionary basis of human nutritional requirements *(see chapter 7).* This is also the basis of understanding human nutrigenomics (how nutritional components affect gene expression) and nutrigenetics (how our genetic heterogeneity affects our response to various nutrients) (Mutch et al. 2005; Wittwer et al. 2011).

Table 30.1 Chapter sequence, titles, authors and page numbers

Chapter number, title and authors	Page numbers
Chapter-01: Dietary proteins: functions and health benefits – KhetanShevkani and Shivani Chourasia	3–37
Chapter-02: Carbohydrates as nutritional components for health and longevity – GözdeOkburan and Ceren Gezer	39–52
Chapter-03: Fats and oils in health and longevity Kaustuv Bhattacharya and Suresh I.S. Rattan	53–62
Chapter-04: Micronutrients in ageing and longevity – BoženaĆurko-Cofek	63–83
Chapter-05: Probiotics and prebiotics in healthy aging – Aayushi Kadam, Deepak Kadam, KanchanlataTungare, Heena Shah	85–108
– Chapter-06: Nutritional hormetins in ageing and longevity – Suresh Rattan	109–122
Chapter-07: Notes towards an evolutionary biology of nutrition – Donovon German and Michael Rose,	123–151
Chapter-08: Animal- and plant-based food for health and longevity – AzzaSilotry Naik, Majeed Jamakhani, Madhavi R. Verneker and S. S. Lele,	155–177
Chapter-09: Fermented foods in ageing and longevity – S. Heeba and P. Nisha	179–192
Chapter-10: Milk and other dairy product trends in health and longevity – Dino Demirovic Holmquist	193–198
Chapter-11: Anti-inflammatory foods in ageing and longevity – Ceren Gezer	199–219
Chapter-12: Nutraceuticals and functional foods in aging and aging-associated diseases – Jatinder Pal Singh, Balwinder Singh, and Amritpal Kaur	221–238
Chapter-13: Food for brain health – Vittorio Calabrese, Angela Trovato, Maria Scuto, Maria Laura Ontario, Francesco Rampulla, Vincenzo Zimbone, Ignazio La Mantia, Valentina Greco, Sebastiano Sciuto, Roberto Crea, Edward J. Calabrese, and Giuseppe Dionisio	239–274
Chapter-14: Nutrition and exercise to maintain physical functioning during ageing – Pol Grootswagers, Marco Mensink, Lisette de Groot	275–298
Chapter-15: Dietary patterns and healthy ageing – Ligia Dominguez and Mario Barbagallo	301–314
Chapter-16: Ketogenic diet, circadian rhythm and aging – Anita Jagota and Sushree Abhidhatri Sharma	315–330
Chapter-17: Diet according to the traditional Chinese medicine for health and longevity – Yifang Zhang	331–356
Chapter-18: Indian traditional foods and diets: combining traditional wisdom with modern science of nutraceuticals and functional foods – Jyoti S. Gokhle, S. S. Lele and Laxmi Ananthanarayan	357–392

(continued)

Table 30.1 (continued)

Chapter number, title and authors	Page numbers
Chapter-19: Diet and circadian rhythms: implications for aging and longevity – Anita Jagota*, Zeeshan A. Khan and M. Sultan Khan	393–409
Chapter-20: Longevity foods in myth, legend and history – Ilia Stambler	411–435
Chapter-21: Nutritional regulation of aging and longevity – Alexey Moskalev	439–464
Chapter-22: Gerosuppressive and senolytic nutrients – Jan Nehlin	465–490
Chapter-23: Role of short peptides as an important nutritional element in maintenance of body homeostasis – Svetlana Trofimova and Vladimir Khavinson	491–506
Chapter-24: Fasting and calorie restriction for healthy ageing and longevity – Sandeep Sharma and Gurcharan Kaur	507–523
Chapter-25: Calorie restriction mimetics and adult stem cells – BauyrzhanUmbayev, Yuliya Safrova, AisluYermikova and Timur Saliev	525–548
Chapter-26: Healthy nutrition for older people – Marios Kyriazis	549–566
Chapter-27: Nutritional regulation of metabesity – Ebenezer I. O. Ajayi, Olorunfemi R. Molehin, Stephen A. Adefegha, Aderonke E. Fakayode, Johnson O. Oladele, and Olawumi A. Samuel	567–588
Chapter-28: Why Ashwagandha for healthy ageing? "Evidence from cultured human cells" – RenuWadhwa, Sukant Garg, Mallika Khurana and Sunil Kaul	589–615
Chapter-29: The fact and fiction of nutritional claims about health and longevity – Eric Le Bourg	617–630

30.3 Food

Almost all the food we eat is of the animal and plant origin, although continuing advancements in nutrition research and innovation of food industry may open up new vistas including man-made synthetic foods. Besides the inherent nutritional composition of plant- and animal-based foods, farming and agricultural practices, methods of food preparation and preservation, and the amounts consumed are equally important factors for their eventual health benefits (see *chapter 8 and 9*). Moreover, prevalent climatic conditions and the local production of raw materials have always challenged human-beings across civilizations and cultures to explore and develop different processes of preservation and modification, such as fermentation. The claimed health benefits of fermented foods are attributed to a combination of bioactive components released as by-products of the fermentation process and the presence of probiotics in these foods, which support the gut microbiota (see *chapter 9*).

Various foods consumed traditionally in different cultures, and some of the claims made for their potential modes of action, have been scientifically validated to some extent. Such foods are often touted as complete foods, anti-inflammatory foods, food for brain, food for physical endurance, functional foods and so on (see *chapter 11–13*). Traditional foods enriched with a variety of phytoconstituents and other minerals, vitamins and natural or synthetic hormetins are generally promoted under the banner of "functional foods". A similar trend can be seen for milk and dairy products with novel and innovative formulationswith a focus on functionality, health, and easy availability (see *chapter 10*).

30.4 Diet and Culture

The next stage after having access to food is the manner in which that food is consumed, and that is what gives it the status of becoming diet or a meal. This is also where the socio-cultural aspects of dietary habits and traditions become more important than the biochemistry and molecular biology of the nutritional components of food (Samaddar et al. 2020). The so-called Mediterranean diet, paleo diet, ketogenic diet, Chinese diet, Ayurvedic diet, vegetarian diet, and more recently, vegan diet, are some of the varied expressions of such social and cultural practices (*see chapter 15-18*). The health outcomes of these variety of dietary and mealing patterns prevalent in different cultures have been helpful in cross-cultural adaptation to both healthy eating patterns on one hand and bringing awareness about the health-risk associations of certain food habits on the other. It is in this context that the subject of chrononutrition, that is how our daily rhythms affect and regulate our nutritional needs, has become an important aspect of healthy eating *(see chapters 17, 18).* Similarly, the so-called "nutrient timing" involves eating foods at strategic times in order to achieve certain outcomes, such as muscle growth, sports performance and fat loss (Kessler and Pivovarova-Ramich 2019). Looking back into the cultural history of longevity foods, one realizes that it is not just the right combination of nutrients which is important, but the elaborate social practices, rituals and normative behaviors for obtaining, preparing and consuming food are equally, if not more, important aspects of health-promoting eating (*see chapter 20*).

Thus, dietary patterns and meal-timing seem to be more predictive of health-related quality of life than foods or nutrients on their own (Fontana and Partridge 2015; Kessler and Pivovarova-Ramich 2019). Encouraging a shift to healthy dietary patterns, however, critically depends not only on the food availability, accessibility and affordability, but also on the behavioral, intentional and socio-cultural conditions of consumers for making their food choices. An old saying that "we are what we eat" may be corrected to that "we eat what we are"!

30.5 Nutritional and Dietary Interventions

Food is often considered as one of the three pillars of human health and survival – the other two being physical activity, and social and mental engagement. Therefore, manipulating and modifying food components and food habits have always been attractive targets for intervention. This is exemplified by extensive research done on the effects of individual nutrients, short peptides, and plant extracts in stimulating, inhibiting or regulating various molecular pathways in relation to ageing, and age-related diseases, including cancer, in experimental animal model systems and cells in culture *(see chapters 21, 23, 28).* More recently, single-nutrient-based or multiple-nutrients-based selective killing of senescent cells, and calorie restriction mimetics as anti-ageing therapies are being tested and developed *(see chapters 22, 25).* These therapeutic strategies follow the same "one target, one missile" pharmaceutical rationale, and consider ageing as a treatable disease. However, often the promises made, based on the results obtained from such experimental studies, are either naïve extrapolations from experimental model systems or overhyped claims for human applications, which deliver very little in reality (Rattan 2020) *(see chapter 29).*

Some other innovative, holistic and relatively easy to implement food- and diet-based interventions strategies are caloric/dietary restriction and time restricted eating (TRE) regimens. For example, intermittent fasting (IF), based on feeding/fasting timing manipulation, is emerging as a promising intervention to promote health and longevity. Meta-analyses of several pilot studies in human subjects show that TRE, with eating restricted to a few hours in the day time, has beneficial effects on several health parameters (Mattson et al. 2014) (*see chapter 24*). Similarly, several other practical recommendations are made for the optimal nutrition in old age (*see chapter 26*), and for the regulation of metabolic syndromes, especially metabesity (*see chapter, 27*).

30.6 Conclusions and Suggestions

Food is more than just being one of the three pillars of health. Food is both the foundation and the scaffolding for the building and survival of an organism on a daily basis. Scientific research on the macro- and micro-nutrient components of food has developed deep understanding of their molecular, biochemical and physiological roles. Various recommendations are repeatedly made and modified for some optimal daily requirements of nutrients for maintaining and enhancing health, and for the prevention and treatment of diseases. Can one envisage developing a "nutrition pill" for perfect health, which could be used globally, across cultures, and at all ages? We don't think so.

So far, most of our knowledge about nutrients comes from the experimental studies made with individual active components, or, at best, with the combination of one

or two compounds. However, in reality, we obtain these nutrients from the food where they exist together with hundreds of other interacting compounds, and become modified through the process of cooking and preservation. Scientifically, there is very little known about the health-related effects of innumerable combinations of food sources, cooking methods, dietary combinations and other factors. However, there is a lot of folk knowledge available in all cultures about the dos and don'ts of food, for which we need scientific verification and validation. For this purpose, we must rethink and modify our presently established scientific protocols of double blinded randomized control trials which are practically impossible to apply on food and dietary research at the population level.

Finally, nutrition, food and diet are the basis of life, health and longevity. We have gathered a huge amount of information with respect to what nutrition is required for health and survival, which foods can provide what nutrition and to what extent, and which dietary and eating practices seem to be more or less health beneficial. Whereas in some parts of the world, abundant availability and accessibility of food has led to its overuse, abuse and consequent life-style diseases, in other parts of the world economic disparity and food scarcity keep perpetuating starvation, malnutrition, poor health and shortened lifespan. It is usually not the lack of knowledge about the optimal nutrition, food and diet that forces us to make bad choices; rather it is either our inability to access such foods, or our gullibility to fall prey to the exaggerated claims in the commercial interests of the food companies, which determine what and how much we consume. Science will and must continue to gather more information about the biochemical, physiological and other aspects of food, which we should apply wisely and globally for the health and longevity of all.

Compliance with Ethical Standards

Conflict of Interest All authors declare they have no conflict of interest.

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