
Abstract

The United Nations Education, Scientific and Cultural Organization's broad concept of the Mediterranean diet (MD) as an 'intangible cultural heritage' constitutes the starting point of this book, which is dedicated to the molecular biochemistry of this eating pattern. The concept of the MD is introduced and discussed, time trends in its evolution are documented, and research results on the associations between MD and health are summarised. The concept of a 'dietary pattern' is used as an integrated approach, enabling the identification and quantification of the associations between the overall diet and specific health/disease outcomes. The analysis of nutritional epidemiology studies, complemented by information provided by studies at a cellular and/or a molecular level, enabled the discussion of the multiple associations between the MD, health, well-being and longevity. This work includes analytical data on food composition, highlighting minor components, many of which are bioactive. Sections were organised by food groups, and examples of every representative food group within the MD were chosen: olive oil and table olives; greens and other vegetables—including grains, fruits, pulses, nuts and aromatic herbs; milk and dairy products; fish, meat and other animal protein sources; infusions and wines. Advances in food analysis are bringing to light a multitude of bioactive compounds. These chemical entities, their content in foods and disclosed mechanisms of action, as well as the effect of diet on microbiota are described here. Several global and governmental organizations acknowledge the MD as nutritionally adequate, health-promoting and sustainable because of its emphasis on biodiversity and the intake of small meat portions. In short, Mediterranean-style dietary patterns score high for health, as well as for estimated sustainability scores and can be followed in Mediterranean as well as in non-Mediterranean countries.

9.1 The Mediterranean Diet: Concluding Remarks

The United Nations Education, Scientific and Cultural Organization's (UNESCO's) broad concept of the Mediterranean diet (MD) as an 'intangible cultural heritage' constitutes the starting point of this book, which is dedicated to the molecular biochemistry of this eating pattern.

'Good Mediterranean diet', 'prodigious Mediterranean diet', 'healthy Mediterranean diet', or simply 'Mediterranean diet': under these designations, there is a vast diversity of food patterns in the area surrounding the Mediterranean Sea. With reference to some claims stating 'there is no such thing as a Mediterranean diet', we would argue that, for the sake of accuracy and precision, the plural should be applied: Mediterranean diets. Actually, the MD of people living in Sicily certainly differs from that of people living in Marrakesh. So the broad 'Mediterranean diet' designation encompasses the numerous variants of food patterns spanning from countries facing the Atlantic, such as Portugal and Spain, to those neighbouring the Near East, such as Cyprus, or bordering the Sahara desert, such as Morocco. The strength of the concept behind the MD is its harmony with the people and the environment, as food habits are a product of ecological forces acting within the context of historical conditioning and belief systems (Fieldhouse 1995).

Food and eating are basic needs but also sources of pleasure and enjoyment and occasions for socialisation and bonding. Such links, represented by convivial meals, are more evident among peoples that actually share the food from the same plate. The *diaita*, as a Mediterranean way of living, is originally linked to rural landscapes, the seasons of the year and traditions and cultures, supporting sustainable agriculture and food habits. Many regional variations occur; however, there is 'unity in such diversity', with common features identifiable in the diets of the Mediterranean peoples that are central to its identity:

- Meals are opportunities for socialising
- Wine and infusions play a central role in these convivial meals
- Cooking methods are generally simple, and natural fresh ingredients are preferred over processed ones
- Olive oil is the main fat in the diet and is used for both cooking and seasoning
- Large daily intakes of seasonal vegetables, pulses and fruits are observed
- Tomato, onion and garlic are common ingredients through the Mediterranean area (many dishes starting from a base of fried onion, garlic and tomato in olive oil)
- Wheat is a staple food, providing starch and oligosaccharides, while simple sugars (consumed in desserts) are reserved for festivities and seldom consumed
- A low intake of dairy products, with a preference for cheese and yoghurt is observed
- A low intake of meat and fish (traditional preserves, as ham, chorizo, salami and anchovy paste are often used to flavour dishes where vegetables are predominant) is observed

Many factors determine eating patterns. Urbanisation has brought populations to cities, inducing its detachment from a natural pace. A large number of these individuals claim that they have no time or skills to cook. Agriculture evolved to energy- and water-intensive systems. Planted monoculture fields and large cattle exploitations replaced traditional farming systems, where plant diversity was paired with animal husbandries, or fishing, thus providing local diversified food resources. A global food industry became stronger and powerful, influencing the average consumer's demands (namely for sugar, saturated fats and salt) and marketing similar food items worldwide. Fast food, ready-to-eat and frozen pre-cooked meals are considered by many people an adequate response to save time and avoid cooking. In contrast with the MD, these globalised food patterns are based on meals that can be readily eaten at a desk while performing some job or on a couch while watching television. Major ingredients include high amounts of refined carbohydrates, sugars, salt, saturated and *trans*-fats and animal proteins. Artificial colourings and flavours are included to attract consumers. In general, vegetables and fruits are rarely included in this type of diet, which is also characterised by a lack of variety. Preferred drinks are of an industrial nature (such as soda, cola and beer) as opposed to wine and infusions.

A consequence of these food trends is that, in 2001, chronic diseases already contributed to approximately 60% of the total reported deaths in the world and approximately 46% of the global burden of disease (WHO 2003). Still according to the same source, chronic diseases are expected to increase to 57% by 2020, overloading healthcare systems and increasing public and private expenses with health. Obesity and chronic non-communicable diseases, such as diabetes, certain types of cancer, cardiovascular and some neurodegenerative diseases are showing worrying trends, as they are being found earlier in life.

The concept of food or a dietary pattern includes the type, quantity, proportions, variety and combinations of foods and beverages consumed (DGAC 2015). It enables the identification and quantification of the associations between the 'overall diet' and specific health/disease outcomes. This integrated approach to diet looks at interactions amongst its several constituents and overcomes collinearity (between single foods, nutrients and other components). However, time distribution (be it circadian distribution, weekly and/or seasonal consumption), preparation and cooking methods as well combinations of foods and drinks consumed together should also be regarded as part of the dietary pattern, as they influence several outcomes.

Nutritional epidemiology has unveiled multiple associations between the MD, health, well-being and longevity. Biochemistry, molecular biology, genetics, physiology and other scientific disciplines widened and complemented such research by identifying and quantifying the compounds in foods and providing evidence on their physiological mechanisms and actions.

This book examines the MD at a molecular level, establishing connections to health and well-being. Findings from epidemiological studies in which associations between adherence to the MD and positive health outcomes have set the scene for the presentation of the main groups of foods that are central to the MD. Information

about foods is conveyed by several sources, including labelling of pre-packaged, processed foods. However, such information only covers specific nutrients and is not easily available for fresh foods. Herein, we presented detailed compositions of foods resulting from the compilation of data from institutional databases and from bibliographies. Food processing strongly influences its composition, namely in minor constituents. Although fresh ingredients should be preferred, industrially processed foods constitute an important part of current diets, especially of urban populations. Food processing may contribute to the preservation of nutrients (e.g. vitamins) and increase the bioavailability of active components (e.g. lycopene). On the other hand, the incorporation of sugars and fat in many foods through industrial processing has led to a wide availability of high-energy-dense foods at affordable prices. This contributes to the imbalance between energy requirements and energy intake, a major determinant of overweight/obesity.

In the first sections of this book, the concept of the MD was introduced and discussed, time trends in its evolution were documented, and research results on the associations between the MD and health were summarised. Nutritional epidemiology research has been crucial to establish associations between the ‘prodigious Mediterranean diet’ (Peres 1997), well-being and health, and longevity of the populations following this food pattern, as first studied by Ancel Keys, a well-known American physician.

The further sections of this book are organised by food groups and bring a complementary view of the MD by focusing on its chemical aspects. In each section, examples of every representative food group within the MD have been chosen (olive oil and table olives; greens and other vegetables—including grains, fruits, pulses, nuts and aromatic herbs; dairy products; animal protein sources; infusions and wine) to be presented and discussed. The composition of the selected food items are mainly based on data from two public food databases: the US Department of Agriculture (USDA) food database, which covers food items available in the USA, and the Portuguese Food Information Resource (PortFIR) from the Portuguese National Institute of Health (Instituto Nacional de Saúde Doutor Ricardo Jorge [INSA]), which covers food items available in the Portuguese market.

Advances in food analysis are bringing to light a multitude of components with biological activity, and an increasing number of minor constituents of food matrices have been identified and quantified.

It is worth noting that the reported food composition in nutrients, as well as in bioactive components, depends on many factors—from the location and season to the analytical methodology. Moreover, food composition is not static and, therefore, figures provided via chemical analysis should be regarded only as indicative values. Furthermore, analytical methods are not standardised between Europe and the USA, giving leeway for different findings. However, we found data to be most often convergent, which helps in understanding the figures.

Many minor components of foods, although present in small amounts, have important biological functions. Synergistic effects amongst them have subsequently been hypothesised and proven by research at molecular, cellular and tissue levels.

This book describes these chemical entities and their level in foods as well as their mechanisms of action.

Besides minor constituents of foods, such as phytosterols, essential fatty acids or proanthocyanidins (discussed in the corresponding sections), diet/food patterns influence the gut microbiome, which in turn strongly influences health in several ways. Gut microbiota composition is influenced by many factors, of which breastfeeding is of utmost importance, strongly affected by the diet and body mass index of the mother (Cabrera-Rubio et al. 2012). Diet during childhood helps to build the microbiota, which reaches a steady state in adulthood and is thought to determine immunity, tendency to obesity, and even mood (Kelly and Mulder 2012; Logan 2015; Susuki and Worobei 2014; Voreades et al. 2014). Some food components are known to benefit gut health, as is the case for fibres, oligosaccharides and polyphenols. On the other hand, excessive intake of simple sugars, sulphur-containing amino acids (from animal proteins), aspartame and some food preservatives, have been proven deleterious to these microbial communities. This field of study is developing rapidly, aiming to understand how environment, diet and host genetics influence the microbiota/microbiome and identify its relationships with health outcomes.

In addition, the book succinctly touches on the negative impacts of harmful ingredients and the risks of excess salt and trans-fat intake.

This evidence contributes to an explanation of why the MD constitutes a paradigm, a valuable resource for the formulation of nutritional theoretical models and applied healthy eating patterns. In fact, this dietary or food pattern is one of the recommended patterns to the general US population (DGAC 2015; USDA and USDHHS 2010).

Recently, the Scientific Report of the 2015 Dietary Guidelines Advisory Committee (DGAC) identified the MD (in the report, *Healthy Mediterranean-style Pattern*) as one of the three patterns with available research data on nutritional adequacy and associated health benefits. Features of a healthy dietary pattern include a high level of vegetables, fruits, whole grains, low- or non-fat dairy, seafood, legumes, and nuts; moderate consumption of alcohol (among adults); low consumption of red and processed meat; as well as low consumption of sugar (sucrose), sweetened foods and drinks and refined grains.

Along with the healthiness of diets, scientists and policy makers are increasingly acknowledging the issue of their sustainability (Burlingame and Dernini 2011). The UN Food and Agriculture Organization (FAO) has identified the MD as an example of a sustainable diet due to its emphasis on biodiversity and smaller meat portions (FAO 2008, 2010). The UNESCO recognises that the MD is rooted in respect for the territory and biodiversity. The most recent report from the US DGAC analyses for the first time the impact of foods and drinks on environmental outcomes, recognising that dietary recommendations should promote both health and sustainability (DGAC 2015). The identification of dietary patterns that are nutritionally adequate, promote health and also protect natural resources showed that the MD or a Mediterranean-style diet (in Mediterranean as well as in non-Mediterranean countries) had favourable environmental outcomes such as

reduced greenhouse gas emissions, agricultural land use and energy and water consumption. Of great significance is the fact that Mediterranean-style dietary patterns scored high for health as well as for estimated sustainability scores (DGAC 2015). These findings reinforce the concept of the MD as a cultural pattern that is both deeply rooted in the past and soundly facing the future.

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