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Mediterranean Diet

Food Heritage and Gastronomy

Mediterranean Diet: When brand meets people

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MEDITERRANEAN DIET- FOOD HERITAGE AND GASTRONOMY

ABSTRACT

In this module, Mediterranean Diet (MD) will focus on one of its dimensions: the food pattern, which has been used as a case study of a healthy and sustainable diet, and as a worldwide inspiration for dietary guidelines and recently designed diets. Mediterranean Diet, as whole is a unique feature found in the Mediterranean area, as it encompasses elements of geography and climate, agriculture, food habits, history, sociological aspects, culture, architecture and other. On one side, it is necessary to preserve the fragile equilibrium that is the true MD. On the other side, some features of the MD can be implemented elsewhere with benefits for all, as the eating pattern or the reconnection of urban populations with the paces of nature. In this module, the Mediterranean food pattern is presented as well as the benefits that have attracted so much attention from outside the region. Thus, the food pattern and lifestyle will be herein reviewed: from the health and nutritional point of view, highlighting the balance and frugality of Mediterranean eating habits; from the environmental point of view - highlighting the variety and biodiversity of foods; and from the culinary point of view – for the wide spectrum of flavours, textures and colours of Mediterranean foods. In short, this module aims at providing information on the Mediterranean food pattern to encourage educated choices on eating habits and lifestyle. Moreover, it will stress that the pleasure of good food and convivial meals is more than compatible with a healthy and sustainable lifestyle. From now on, and for the sake of simplicity, the Mediterranean food pattern will be abbreviated as Med diet, and the Mediterranean Diet concept will be abbreviated as MD.

1. MEDITERRANEAN FOODS

As presented in the course overview and further explored in the first module of this manual, **the MD is a multidisciplinary concept, which is directly related to the geoclimatic features of the Mediterranean region, prevalent agricultural and fishing activities and historical influences.** The Med diet is probably the dimension of the MD that has been attracting more attention. **The eating habits of the peoples of the Mediterranean started to be shaped in the agricultural revolution**, evolving over time in accordance to cultural and natural constraints. It is an empirical dynamic concept conditioned by nature (including traditional Mediterranean agricultural systems) and by cultural and historical features.

As explained in module 1, several civilizations have been shaping the Mediterranean identity and way of life. In what respect to foods patterns, it is noteworthy that the linkage between food and wellness was established by ancient Greeks, the standardization of food habits and crops was promoted inside the Roman Empire, and Med diet was enriched by the Portuguese and Spanish with animal and plant species originated from the Americas.

The biodiversity within wheat, olives, grapes, citrus fruits, tomato, potato, carrots and so on, is mostly the result of the combined efforts of nature and humankind: the evolution and human selection of domesticated plants resulted in cultivars adapted to specific habitats, as well as the evolution and human selection of animals resulted in specific breeds (Fig. 1).

Figure 1. *Citrus fruits from Algarve, Portugal, showing some of the genetic variety within the genus Citrus, which can be found in that region. Such variety of colours, sizes and forms results from combined works of man and nature in adapting and selecting plants to best fit specific environmental conditions, thus improving agrobiodiversity, which is a valuable asset, both nutritionally and in coping with climate change. (Photo by D.C.D. DRAPAlgarve)*

Such features translate into regional specificities, notably the large agrobiodiversity of the MD: despite the common food groups, each region has unique olive oils, unique citrus fruits, unique cheeses, unique breads, and so on. Again, there is a "unity in diversity" at the level of food habits, in which agrobiodiversity can be viewed as a "customization". During millennia, an enormous number of local plant varieties proliferated in the Mediterranean to meet agricultural and nutritional needs, based on optimal local resources exploitation. The process of introducing and adapting new species is dynamic and ongoing. Agrobiodiversity and the sustainable use of resources are nowadays recognized of capital importance in reactivating Mediterranean agricultural systems, and traditional varieties (as well as autochthone animal breeds) are the best ambassadors of their landscapes, improving social and cultural resiliency[1].

In the words of Trichopoulou and Lagiou[2],

"*The Mediterranean Diet and lifestyle were shaped by climatic condition, poverty and hardship rather than by intellectual insight or wisdom. Nevertheless, results from methodological superior nutritional investigations have provided strong support for the dramatic ecologic evidence represented by the Mediterranean natural experiment*"

Such "natural experiment" was first reported by an American doctor, Ancel Keys, in the 1950's, when USA and Northern Europe were experiencing a high economic growth and food industries were on the rise. Keys found a very different reality in southern Europe that he approached from a public health perspective. In the famous "Seven Countries Study", Keys and co-workers demonstrated an inverse correlation between adherence to the MD and the incidence of coronary heart disease[3].

The mounting evidence on the direct correlation between these eating habits and health outcomes are presented and discussed below in 3.1.

Keys described the diet and lifestyle he observed in southern Europe shortly after second world war as consisting of frugal meals with wheat, wine and olive oil as key elements. He described meals as communal events that included many vegetables and herbs and very small amounts of meat and fish, with pulses and cheeses as the preferred sources of protein. Cooking methods were simple, despite the resulting variety of flavours and colours. Seasonal fruits were the preferred desserts, and nuts and olives were eaten as snacks. Coffee and tea played an important role in these communal meals, and sweet desserts were reserved for festivities, when the intake of meat and fish was also increased.

1 https://memolaproject.eu/node/2319

2 Trichopoulou A, Lagiou P (1997) Healthy traditional Mediterranean diet: an expression of culture, history, and lifestyle. Nutr Rev 55:383–389. doi:10.1111/j.1753-4887.1997.tb01578.x

3 Ancel Keys (ed), Seven Countries: A multivariate analysis of death and coronary heart disease, 1980. Cambridge, Mass. Harvard University Press. ISBN 0-674-80237-3.

This Mediterranean Food pattern (Fig. 2 and 3) follows common basic features with a place for regional specificities:

Strong difference between everyday meals and festivity occasions. Frugality is the rule, although common meals are varied and tasty;
Daily meals are convivial moments, during working breaks with colleagues or at home, with all the family gathered around the table;
Olive oil is the main fat, and a key food ingredient, with daily intakes of about 20 ml/capita/day;
Abundant consumption of vegetable and seasonal fruits from local orchards, kitchen gardens or local markets;
Animal-based products are used to enhance the flavour of dishes.

In short, in the "good mediterranean diet", a term coined by Ancel Keys, scarcity was the rule; abundance was the exception. Only during festivities, people indulged themselves in eating larger amounts of fish, meat and sweet desserts. Everyday meals, however, included a large variety of ingredients and seasonings, resulting in complex flavour and nutritional richness. In addition, in the 1950-1960's Mediterranean peoples often engaged in physically demanding occupational activities.

From the 1990's onwards, and for a variety of reasons, this healthy and sustainable eating pattern has been fading away in the area, facing now the global issues of obesity and nutritional deficiencies, as well as threats such as the environmental impact of food systems.

The generalization of the so-called western diet is to blame; the use of a few cheap ingredients in ultra-processed foods[4], which are available and massively advertised worldwide, encourages children's obesity trough marketing campaigns targeting children and youngsters that respond with covenant behaviours. Such cause-effect relationship was object of recent studies, which show that marketing unhealthy foods (in tv, social media and packaging) negatively impacts children's food preferences, dietary habits and health[5].

These ultra-processed foods evolved to take advantage of technological and sensorial properties of fat (particularly of palm oil derivatives, mostly non-sustainable and rich in industrial trans-fats, or i-TFA[6]) combined with added sugar[7] and salt, in conveying the soft textures and basic flavours

4 Ultra-processed foods are industrial products containing more than 4,5 ingredients that may include additives, hydrolysed proteins, modified starches, emulsifiers, hydrolysed fats (and trans-fats) and flavour enhancers. Such products are generally presented as ready-to-eat or ready-to-cook, and are generally dense in calories, nutritionally poor and with excessive levels of simple sugars (e.g. glucose, sucrose), fats, salt and other health-deleterious compounds. More information about such definition can be found in Monteiro et al (2018) and in Fardet A (2018) - detailed references are provided in the reading list;

5 Elliott C. (2019). Tracking Kids' Food: Comparing the Nutritional Value and Marketing Appeals of Child-Targeted Supermarket Products Over Time. Nutrients. 11(8). pii: E1850. doi: 10.3390/nu11081850. & Sadeghirad et al. (2016) Influence of unhealthy food and beverage marketing on children's dietary intake and preference: a systematic review and meta-analysis of randomized trials. Obes Rev. 17:945-59. doi: 10.1111/obr.12445.

6 **I**ndustrially originated **T**rans-**F**atty **A**cids (i-TFA) do not occur in nature. According to WHO, diets high in trans-fats (of natural and industrial origin) increase heart disease risk by 21% and deaths by 28%. available at: https://www.who.int/news-room/detail/14-05-2018-who-plan-to-eliminate-industrially-produced-trans-fatty-acids-from-global-food-supply

7 Corn syrup, a cheap fructose-rich industrial sweetener is most probably implicated in health issues, according several authors, as: Sadowska J, Rygielska M. (2019) The effect of high fructose corn syrup on the plasma insulin and leptin concentration, body weight

well accepted by many consumers. As a result, the combinations fat & salt or fat & sugar are widespread in bread, yogurt, ready-to-eat or ready-to-cook meals etc., accounting for the so-called "hidden calories" and many health-deleterious effects (additional information in footnotes).

The role of food industries is crucial in ensuring food security, namely by preserving and transforming fresh produce that otherwise would be wasted (e.g. making juice from excess orange production, transforming tomato, or freezing veggie mixtures). However, the current global paradigm of the food sector is non-sustainable, in both environmental and public health terms and must change, under the commitment of the UN SGD 2030 agenda.

While other aspects of the Mediterranean culture coined the western civilization long time ago, the Med diet only recently has been under the spotlight; their balanced features have been noted outside the Mediterranean, specially the health benefits that come along with the low environmental impacts and social benefits, thus serving as inspiration for recently formulated diets (e.g. Nordic, flexitarian).

The millenary wisdom enclosed in the MD may hold the key to overcome global issues of today helping to leverage the relationship between man and nature, as noted by FAO that supports the initiative on "Mediterranean Diet's Principles for Agenda 2030"[8]. To enable retrieving the lead in this field, Mediterranean dietary pattern will be analysed below, in respect to their features and benefits, the existing traditions and gastronomy as well as motivations to follow such food habits.

2. FEATURES

2.1. THE MEDITERRANEAN FOOD PATTERN

The Mediterranean diet was first studied and described in detail by Ancel Keys, who's pragmatic recommendations were mostly ignored for decades, mainly because the non-compliance to the standardization and mass production model of the industrial revolution. While some once balanced Mediterranean foods inspired global fast-food counterparts (e.g. pizza), others have just been devoted to oblivion.

MD dietary pattern has been undergoing an erosion, with the fast decline of adherence scores in the area, particularly among youngsters and specially since 2000. These observations point to a nutrition transition period that encompasses considerable changes in diet and physical activity patterns, which is a direct pathway to an increase in the incidence of chronic and degenerative diseases. A reversal of the decreasing adherence to MD urges and will require an approach at various levels and in a wide range of settings. To revamp the MD among urban populations and youngsters with today's technologies means bridging the gap between old traditions and nowadays' issues maybe rethinking the communication and motivation strategies. The pride in traditions and the sense of belonging are perhaps less important to younger generations than the actions to minimize environmental impacts and climate change. Maybe showing the sustainability

gain and fat accumulation in rat. Adv Clin Exp Med. 28:879-884. doi: 10.17219/acem/94069. & .Spagnuolo et al. (2020) Brain Nrf2 pathway, autophagy, and synaptic function proteins are modulated by a short-term fructose feeding in young and adult rats. Nutr Neurosci. 23:309-320. doi: 10.1080/1028415X.2018.1501532.

8 A call from the past: ancient knowledge for a sustainable management of land and water resources. In: http://www.fao.org/land-water/resources/events-detail/en/c/1260497/

of the Mediterranean dietary model, along with the adoption of healthy food habits since childhood, and the development of cooking skills may contribute to ensure the long-term implementation of the Mediterranean Diet.

To overcome current issues, we will need to analyse the history and inspect the drawbacks. Thus, going back in time, and as above-mentioned, Med diet is grounded on the food habits and traditions of rural communities (from the olive-growing areas of the Mediterranean basin) before the rise of food industry into global corporations, and before the dissemination of the fast-food culture. Such communities were often isolated, experiencing economic difficulties, and consequently developed skills and techniques to optimize the use of all available resources, while minimizing waste. Such wisdom needs to be revisited in finding the path to comply with sustainable development goals.

It has been argued that Med diet is an ideal model, a utopia, because in the Mediterranean many dietary patterns co-exist instead. In fact, the Med diet encompasses a myriad of regional variations but there is a "unity in diversity" under a same purpose – making the best use of agrobiodiversity of each region, and of each season; all this diversity is grounded on a few common pillars, summarized below. Cultural aspects are embodied in the countless number of regional plates, customs, and typical food products that can be found in the Mediterranean basin (as further explained in section 5). Besides the common ground of regional cuisines, also common habits can be identified: the pleasure of the table, the sharing of the food, the hospitality, yet the frugality of food habits, as well as the food waste minimization.

The dietary guidelines for a moderately active healthy adult, (with a normal BMI)[9], are summarized in Fig. 2 and 3. Such dietary guidelines are being prescribed worldwide for weight control and non-communicable diseases' prevention. It has also been used as a case-study and as an inspiration in developing identical dietary models to apply elsewhere in improving the environmental performance of currently disrupted food systems.

As referred above, presently the Med diet adherence scores in the Mediterranean are becoming lower and lower – a situation that urges to be retreated. Whatever the strategy to do so, it is of utmost importance to get familiar with, to disseminate and to raise awareness on this food consumption pattern, noting that health and environmental benefits of the Med diet will be addressed in section 2.3.

9 BMI stands for Body Mass Index, which is a measure of the body fat obtained from a numerical expression relating the mass and height of a per

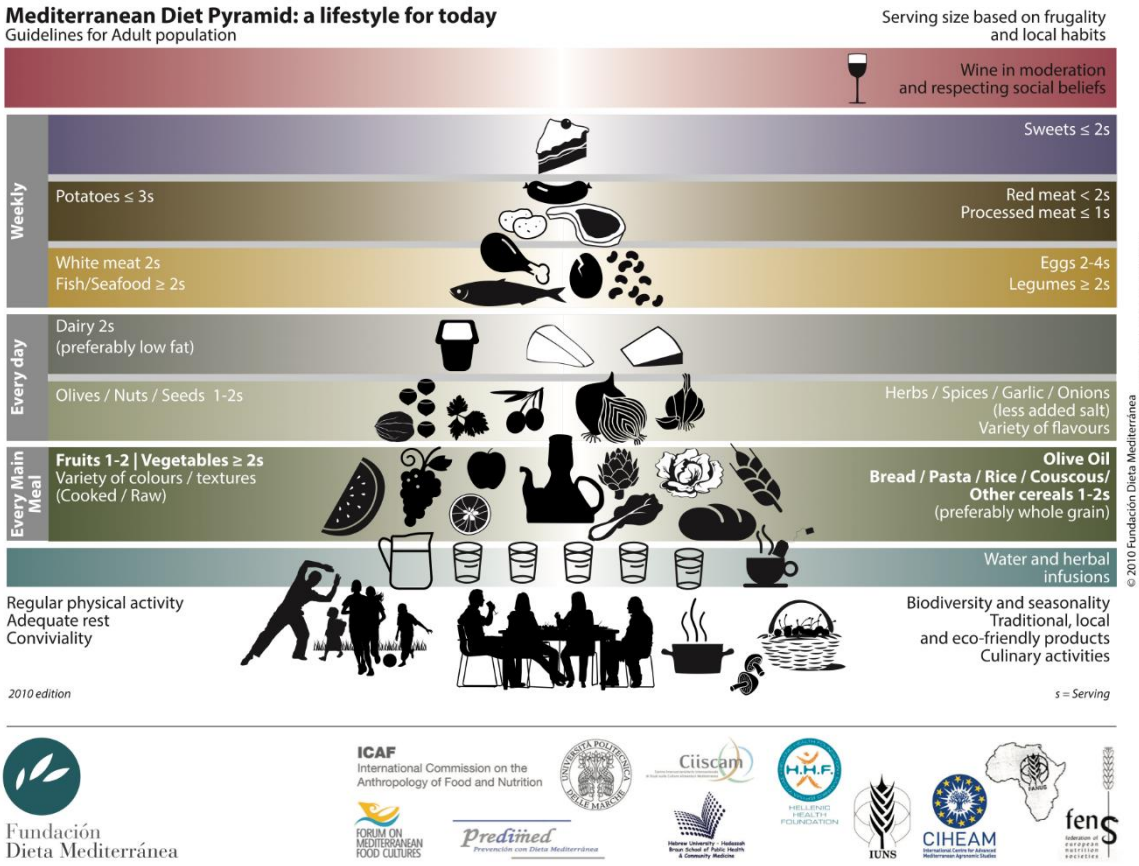

Figure 2. Mediterranean Food (source: Fundacíon Dieta Mediterránea, the Pyramid, available at: https://dietamediterranea.com/en/nutrition)

Firstly, Med diet means to eat with parsimony, observing a simple rule of thumb: the intake of energy should not exceed its expenditure, thus limiting the amount of food ingested and keeping an active lifestyle (the human energy requirements depend on many factors, from age, to physical activity, but for general purposes, the mean value of 2000 Kcal/day has been used as reference for a healthy adult).

Secondly, the Med diet is a vegetable-based food pattern, meaning that the intake of vegetables should be much higher than the intake of animal-based foods – noting that the plant-based foods occupy the two lower level rows of the pyramid (Fig. 2) and more than 3/4 of the wheel (Fig. 3).

Third, while the so-called Western diet derives mainly from the same 12 plants and 5 animals all year round[10], in the Mediterranean dietary model, variety is the rule: the wide range of available fish, shellfish, fruits, herbs, vegetables, etc., seem to present endless options. Such variety is well illustrated in the Mediterranean food's wheel (Fig. 3). In fact, the Mediterranean basin is a rich biodiversity spot, still harbouring a great agrobiodiversity, which safeguard is at risk[11].

10 https://www.smithsonianmag.com/smart-news/extinction-threatens-foods-we-eat-180965081/
11 https://www.bioversityinternational.org/news/detail/integrating-wild-and-agricultural-biodiversity-conservation-why-we-need-both/

Figure 3. The Mediterranean dietary pattern exhibited in the wheel/plate format, highlighting the diversity of food items within each food group, and emphasizing the social perspective, as the convivial around the table. Source: https://nutrimento.pt/cartazes/a-roda-da-alimentacao-mediterranica/

As can be observed in Fig. 3, almost half of the daily ingested food should consist in fresh fruits and vegetables and a fair amount of starchy foods should ensure most of the daily energy supply, as complex carbohydrates (starch, oligosaccharides and fibres) should be preferred to simple sugars (as sucrose or glucose). Pulses should provide for a significant part of the protein requirements and dairy products are a complementary sustainable source of animal protein, allowing reducing the intake of fresh meat and fish. Finally, olive oil (preferably of extra-virgin grade) should be the main lipids' source.

The daily intake of nutrients, necessary to sum up about 2000 Kcal/day/person, are detailed in Table II, and correspond to the shares illustrated in Figs. 2 and 3. Table I summarizes the nutritional features of the Mediterranean dietary model, in terms of the main food sources of macronutrients, phytochemicals and fibre in relation to the total energy intake.

Table I -Main nutritional features of the Mediterranean food pattern

Nutrient	Main Food sources	% Energy intake	Energy intake Kcal	Comments
Carbohydrates	Wheat and other cereals	60-70	1200-1400	> 50% starch
Protein	Pulses, cereals and other plants, dairy, eggs, fish and meat	10	200	High biological value from animal and plant sources
Lipids	Olive oil, fish, nuts	20-32	400-640	Predominantly mono-unsaturated and poly-unsaturated fatty acids with n3:n6 ratio approx. 2:1; modest intake of saturated fats from meat and dairy
Dietary phytochemicals[12]	Wine …… Tea, coffee Spices and herbs	4-7 …… Not applicable	80-140	Alcoholic drinks are forbidden by Islam; green tea, which is staple drink in north Africa, also contains high level of tannins; relevant contribution by seasonings
Fibre	Fresh and dry fruits, grains, nuts, fresh vegetables	Not applicable	Not applicable	The high level of vegetables in the diet also provide vitamins and phytochemicals

(Adapted from Vaz Almeida M.D., Parisi S., Delgado A.M. (2017) Food and Nutrient Features of the Mediterranean Diet. In: Chemistry of the Mediterranean Diet. Springer, Cham. https://doi.org/10.1007/978-3-319-29370-7_2)

Examples of Mediterranean food products (namely PDO and PGI) as well as culinary recipes, easily and rapidly reproducible, are presented below; meanwhile it is important to note that **Med diet has no place for:**

- → **Ultra-processed foods** (detrimental to health and generally non-sustainable);
- → **Fast-food** (rich in calories and in substances detrimental to health; nutritionally poor);
- → **Sodas and artificial candy** (high content in simple sugars and/or artificial colorants, nutritionally not relevant or event detrimental to health);
- → **Chips and other calorie-dense and nutrient-low foods** not included in above categories.

2.2. PLEASURE OF THE SENSES AND CONVIVIALITY

To associate "healthy" with copious taste appears to be a difficult equation. However, the Med diet has spurred this betting because this equation is already one of their pillars, due to its potential to

12 Dietary phytochemicals (also known as phytonutrients) are plant secondary metabolites that may beneficially affect human health, as polyphenols, carotenoids and others

stimulate the senses through a wide range of colours, flavours, aromas, and scents, which are mainly conveyed by the large quantities and large varieties of plant-based foods.

The Mediterranean cuisine is colourful, flavourful, contains a multitude of ingredients, and yet, meals are rapid and easy to prepare, as illustrated by the photos below, of an hypothetical lunch encompassing – a seasonal vegetable soup (potato, onion, carrot, pumpkin, coriander and olive oil, for instance), a pasta dish garnished with pesto-sauce[13], accompanied with a glass of red wine, and grapes for dessert (Fig. 4).

Figure 4. Elements of a Mediterranean daily meal, showing the dominance and variety of vegetables, as well as the social perspective of sharing food. From left to right: a vegetable soup (Photo by Sandie Clarke on Unsplash), some pasta with pesto sauce (Photo by Eaters Collective on Unsplash), wine and grapes (Photo by Roberta Sorge on Unsplash), friends in a convivial meal (Photo by Johanna Dahlberg on Unsplash)

As happened in the old times, nowadays, a Mediterranean meal also offers the opportunity to strengthen social bonds, with colleagues at work, with friends and family at home.

Everyday meals are abundant in ingredients and seasonings[14], chosen by their availability at the season and in the region, can be prepared within minutes, not needing any special skill.

For soup preparation, (top left on Fig. 4) all that's needed is to boil all vegetables in water with salt and add olive oil by the end. The main course (second photo from the left to right) just requires pasta to be boiled in water (seasoned with salt, oregano, basil and olive oil) for a few minutes, while preparing Pesto alla Genovese by mashing and blending the ingredients (basil, pine nuts, olive oil, garlic, salt and cheese - Parmigiano Reggiano and Pecorino) with a mortar and

[13] Relevant information about "Pesto alla Genovese", including the genuine recipe, can be found here: https://www.mangiareinliguria.it/consorziopestogenovese/pestogenovese.php

14 Mainly herbs and spices, fresh or dry, without additives

pestle (see footnote 13); the grapes just need to be washed, and finally, the red wine bottle should be opened a while before serving.

Flavours are enhanced by copious use of herbs and spices, as well as onion and garlic, rather than abusing of salt. A zoom in in the wheel/plate of Fig. 3 will reveal the meaning of the keywords "variety of colour", "texture", "variety of flavours", "biodiversity and seasonality", as nutritional quality is inseparable from sensory quality, and the Mediterranean dishes offer a mouthful for health, and another for pleasure[15].

In the Med diet, the components that convey the nutrients and the health benefits are the same ones responsible for the flavours and colours. Taking the example in Fig. 4: starting the meal with the sweet, warm creamy soup will probably bring a certain sensation of satiety. The main course (pasta) is noteworthy for providing the necessary energy, along with some animal protein conveyed by the cheese (in the pesto sauce), which notably transmits umami flavour. Notes of many aromas and smells can be perceived, given the high number of plant-based ingredients, with a modest yet relevant contribution of an animal-based food (cheese). The variety of colours and textures, and the complexity of flavours enhanced by the wine, topped up by the socialization around the table will certainly bring such a modest and simple meal into the level of a delightful experience.

At the molecular level, it means that vegetable pigments are responsible for the colour, while some of them will also act as provitamins. Molecules that convey aroma (e.g. aliphatic and triterpenic alcohols) are often bioactive too; fibres and polyphenols, significant for food texture, include important health-promoting compounds, and so on.

In western diet, coffee is the major and one of the few dietary sources of phenols, while in the Med diet, polyphenols are prominent and diverse participating, to variable degrees of intensity, in colour, bitterness, astringency, and oxidative stability of food matrices. Much of the intensity of organoleptic properties of plant foods depend on their phenolic profile; e.g. the bitterness of the bread is due to polyphenols from the grain, present when unrefined flour is used; fruits change their colour, astringency and texture when they ripe, resulting in an appealing balance of colour and aromas, thus conveying health and pleasure. Formerly considered as either toxins or anti-nutrients, many polyphenols are nowadays acknowledged for their contribution in disease prevention[16].

3. BENEFITS

Global food system is blamed for climate changes, because it involves activities related to sectors that are responsible for important global GHG emissions[17], namely the energy sector, industry, transport and agriculture. In the EU, in 2017, agriculture contributed with 8.72% of GHG emissions[18], 2/3 of which were form livestock. However, intensive agricultural systems contribute

15 Recipes for Mediterranean meals can be found in: https://dietamediterranea.com/en/recetas/

16 Issaoui M, Delgado AM, Iommi C, Chammem N. (2020). Polyphenols and the Mediterranean Diet. Springer, Cham. https://doi.org/10.1007/978-3-030-41134-3

17 GHG are Greenhouse gases, encompassing CO2, NO2, CH4 and others, and expressed in mass of CO2 eq.

18 Global emissions, and GHG from EU, by country and by sector: https://www.europarl.europa.eu/news/en/headlines/society/20180301STO98928/greenhouse-gas-emissions-by-country-and-sector-infographic

to the depletion of drinking water, pollution and eutrophication and threaten biodiversity, since indigenous crops and livestock breeds are replaced by standardized ones. It is important to note that agrobiodiversity is interlinked with wildlife, especially in the Mediterranean, which landscape mostly results from human-nature interaction (please see module 1 for more information). Moreover, the impact of climate change is expected to reach regions that are not among the major contributors to global GHG emissions, as is the case of the Mediterranean.

Diet-related aspects have enormous impact on Sustainable Development Goals (SGD) and bottom-up actions can be effective drivers for change. The dominant global diet, that is, the western diet, is deleterious for human health and for the climate because it is responsible for food loss and waste (accounting for 1/3 of global food supply) and also for nutritional deficiencies, co-existing with overweight and obesity. For the first time in human History, obesity became a much larger burden than undernourishment, with 38% of adults and 18% of children obese or overweight, against 10.7% of undernourishment, in 2016 (WHO, 2019)[19].

Resynchronizing the food system with nature is an urgent requirement for the humankind and the planet; In changing the current paradigm, once again, the millenary wisdom enclosed in the MD may provide answers and paths. To the well-established health benefits of the Mediterranean Diet, a sustainability dimension was recently added, following the awareness of their overall equilibrium, namely in embracing biodiversity and in reducing food waste. In fact, **a sustainable diet should encompass health benefits, social benefits, economic benefits and environmental benefits,** in order to address SGD.

3.1. HEALTH BENEFITS

The western dietary model is, according to FAO (2004)[20], mostly based on only 12 plants and 5 animals, contrasting with the richness and variety of the MD. Powerful marketing campaigns on ultra-processed foods and sodas targeting children are most probably causing their drift from Med diet pattern and negatively impacting their health (see references of studies in footnote 5). Allegedly, food industries aim at meeting the global consumers' demand for more sugar, salt, fats (including trans-fats[6]), and animal protein, largely exceeding the recommendations of WHO. **Thus, revamping the MD in the area and taking the lead on related actions and innovations is important and urgent.**

Following the pioneer work of Ancel Keys, many other studies succeeded in search for explanations and more evidence to either corroborate or dismantle Keys' arguments. One of such cases, known as the "French paradox", was first presented by Renaud and De Lorgeril, in 1992[21]. The mortality rate for Coronary Heart Disease (CHD) in France was found to be unexpectedly lower than in countries such as the USA and the UK, with similar high patterns of saturated fats dietary intake. The explanation for such paradox was mostly attributed to a differentiating factor: while in the UK and USA, beer and sodas were heavily consumed, French people preferred wine, consumed in moderation during meals. Thus, the wine was found to antagonize the deleterious effects of the ingested saturated fats, in addition to the moderate food habits (French eat smaller doses and more varied food). Further inspections on the mechanism of action of wine on

19 WHO fact sheets, Obesity and overweight: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight
20 FAO (2004) factsheet available at: http://www.fao.org/3/y5609e/y5609e02.htm
21 Renaud S., de Lorgeril M. (1992) Wine, alcohol, platelets, and the French paradox for coronary heart disease. Lancet. 339:1523-1526. doi: 10.1016/0140-6736(92)91277-f.

antagonising fats highlighted the role of resveratrol, which is one of the countless phenols present in red wine.

Since then, the results of many scientific studies (mechanistic and epidemiological studies, as well as meta-analysis) have been reinforcing evidences and explaining the health benefits of Med diet. Med diet continues to be a popular research topic, as PubMed (US National Library of Medicine)[22] returns the following **results concerning the assessment of health benefits of Med diet, in peer reviewed scientific publications, between 1970 and 2019:**

- 2440 scientific papers corresponding to the search "**Mediterranean diet and cardiovascular disease";**
- 1380 studies relating "**Mediterranean diet and obesity**";
- 1172 studies for "**Mediterranean diet and diabetes**";
- 1161 studies relating "**Mediterranean diet and cancer**";
- 498 studies relating "**Mediterranean diet and metabolic syndrome**";
- 198 studies relating "**Mediterranean diet and depression**";
- 167 studies on "**Mediterranean diet and longevity".**

Mainly, epidemiological studies show that the adherence to dietary regimens high in animal-based and ultra-processed foods is associated to a higher risk of non-communicable diseases (NCD), mainly obesity, type II diabetes, coronary and heart diseases, and certain types of cancer. Conversely, higher adherence scores to Med diet (and other Mediterranean-like diets) associate with lower risk of NCD. References of some of the studies, demonstrating such claims, are including in the reading list and in footnotes.

The mounting evidence on the Med diet's health benefits is recognized by international organizations, such as FAO and WHO, highlighting the Med diet as one of the healthiest diets in the world, inspiring national dietary guidelines of several countries (CIHEAM/FAO, 2015).

Recent papers are abundant, unveiling the unceasing **interest on the overall health benefits conveyed by Med diet, as well as analysing the mechanism of action of individual components;** the observed impact is expected to be, at least, a sum of the contribution of the elements of the Mediterranean Diet, as each one shows their own evidence-based health benefits. Thus, in respect to whole foods, the case of olive oil is paradigmatic, as olive oil is one of the few edible oils that can be extracted by means of mechanical forces only, at ambient temperature, and it is edible without any refining operation (Issaoui and Delgado, 2019). Firstly, **olive oil has a balanced fatty acid composition**, concerning n-6: n-3 ratio[23]**;** Secondly, **it contains the essential fatty acids[24] and eicosanoids precursors, linoleic and alfa-linolenic acids (ALA), and supplies vit E and K, thus complying with several nutritional claims of Reg (EC) No 1924/2006, namely in contributing to maintain normal blood cholesterol levels.**

What makes virgin olive oil unique among edible oils and fats is the presence of a so-called non-saponifiable fraction, representing 2% and containing 230 so far identified compounds, a fraction that is eliminated in the processing of other oils and during refining of olive oil. Despite present

22 PubMed is a free search engine accessing primarily the MEDLINE database of references and abstracts on life sciences and biomedical topics: https://pubmed.ncbi.nlm.nih.gov

23 n3 and n6 are commonly known as omega 3 and omega 6 and respect to the position of double chemical bounds in the fatty acid molecules.

24 Essential fatty acids are those that human body is unable to synthesize and therefore need to be provided in the diet

in minor amounts, such compounds are of primary importance to the flavour and health benefits of the virgin olive oil. Hence, the cause-effect relationship between the "Protection of blood lipids against oxidative stress" and the "intake of an adequate amount of hydroxytyrosol and derivatives" was examined by the European Food Safety Agency (EFSA), resulting in a qualified health claim, which applies to some olive oils (most particularly of extra-virgin grade) if containing at least 5 mg of hydroxytyrosol and its derivatives (e.g. oleuropein complex and tyrosol) per 20 mg of olive oil (which is the recommended daily intake, corresponding to about one tablespoon)[25]. The extra virgin olive oil, which is the most valued type, observes demanding quality features, also performing better at nutritional and health benefits' level, as further detailed by Issaoui and Delgado (2019).

Thus, if no more reasons existed, the above listed ones would certainly be enough to justify the central place of the olive products (olive oil and table olives) in the Mediterranean Diet.

Besides the above-mentioned case of wine and olive oil, also the complex carbohydrates (namely from wheat), the fruits and vegetables, pulses, culinary herbs and spices, etc., each one, on its turn contribute with some health outcomes.

Wheat is the world's major cereal crop, with increased demand in tropical and Asian countries while slowly declining in some wealthy economies. As referred in module one, wheat domestication was a major achievement of the agricultural revolution because the grain could be stored thus strongly contributing to food security. Current products from most bakery industries can hardly be called "bread", as most frequently white wheat flour (from which bran is removed) is used along with multiple ingredients and additives. In contrast, traditional bread is made from different local wheat cultivars, using darker and coarsely grinded flours. Besides flour, only water and yeast are added, and the fermentation is long, resulting in a more complex aroma profile, contributed by yeast secondary metabolites and by the polyphenols from the bran fraction. The demand for the so-called "long fermentation bread" is high among some urban consumers due to their perception of enhanced sensorial and health-related aspects. Moreover, dietary fibers, complex starches, and oligosaccharides, abundant in whole or coarsely grinded flours, are of primary importance to gut's health, including by favoring beneficial microbial populations of gut microbiota, that in turn, interfere with body responses, from immunity to mood (Nishida et al, 2018; Strandwitz, 2018).

Such health outcomes to gut microbiota have been referred to be associated to dietary fibres and oligosaccharides (prebiotics) from complex carbohydrate sources, short-chain fatty acids and microbial metabolites from fermented foods (as cheeses and yogurts), and dietary phytochemicals, as non-vitamin carotenoids (e.g. xanthophyll and lycopene) and polyphenols, from plant-based foods.

It is never excessive to stress that one of the main features of Med diet is the abundant intake of a wide variety of fruits and vegetables, nuts, herbs and spices, which benefits are well-established and detailed in works from the reading list. Table II shows a compilation from scientific literature of the potential health benefits, conveyed by herbs and spices, and the main compound(s) from each one. When going down at the molecular level, a class of compounds stands out for its variety, sensorial and health promoting properties – which are phenolic compounds or polyphenols, encompassing a wide range of plant secondary metabolites, from small molecules to large polymers. All sub-classes of polyphenols share "in vitro" anti-oxidant activities as well as other demonstrated "in vivo" actions, as is the case of plant sterols and stanols on lowering cholesterol

25 https://www.efsa.europa.eu/en/efsajournal/pub/2848

levels in blood[26]. Plant sterols (or phytosterols) are abundant in nuts (e.g. pistachio, almond), seeds, fruits (e.g. berries) and vegetables (e.g. broccoli), etc. Health claims related to polyphenols are referred above for olive oil and it is worthy to mention that nuts also comply with the same European framework of nutritional and health claims, notably walnuts (from *Juglans regia*) which help maintaining normal blood cholesterol levels complying with Article 13(1) of Regulation (EC) No 1924/2006[27]

The Mediterranean cuisine is simple but rich, with colours and flavours varying from season to season and from region to region, in a balanced way and, the abundant use of seasonings (herbs and spices, and a few plain ingredients) is noteworthy for being a central feature of Med diet and it is therefore included in closing this section. The documented health benefits of common seasonings of the Mediterranean cuisine are certainly noteworthy. Table II highlights some of the spices and culinary herbs frequently used in the Mediterranean, and which are mostly native or endemic to the region. Many more herbs could be added to the list.

Table II – Health benefits of common seasonings used in the Mediterranean cuisine

Spice/Culinary herb	Main active compound	Reported health benefits	Particularities
Cloves (flower buds of *Syzygium aromaticum*)	Eugenol	Antioxidant, neuroprotective, antipyretic, anti-inflammatory, antifungal and analgesic properties;	One of the foods with a higher concentration of total polyphenols, including gallic acid;
Laurel (leaves of *Laurus nobilis*)	1,8-Cineole	Antioxidant, anti-microbial, anti-diabetic, anti-inflammatory, and anti-carcinogenic activities;	A wide range of aromatic compounds and polyphenols have been identified, encompassing alkaloids, simple phenols, flavonoids and pro-anthocyanidins;
Saffron (from the flower of *Crocus sativus*)	Safranal, kaempferol	Antioxidant, anti-carcinogenic anti-depressant, anti-microbial, and anti-convulsant activities;	The colour is due to the carotenoid pigment crocin;
Coriander (fresh leaves of *Coriandrum sativum*)	Linalool, quercetin	Antioxidant, anti-cancer, anti-microbial, anti-thrombogenic, and neuroprotective activities;	Contains relevant quantities of vit C and carotenoids, in addition to many polyphenols;
Cumin (seeds of *Cuminum cyminum*)	Cuminaldehyde	Antioxidant, anti-allergenic, anti-platelet aggregation and hypoglycaemic effects;	Polyphenol fraction is dominated by kaempferol and caffeic acid;
Oregano (mostly dry leaves of *Origanum vulgare*)	Naringenin	Antioxidant, anti-microbial, anti-cancer, anti-inflammatory, and immunomodulator activities;	Rich in terpenes, phylloquinone and carotenoids, in addition to a relevant polyphenol fraction;

26 https://www.efsa.europa.eu/en/efsajournal/pub/2693
27 https://www.efsa.europa.eu/en/efsajournal/pub/2074

Spice/Culinary herb	Main active compound	Reported health benefits	Particularities
Rosemary (leaves of *Salvia Rosmarinus & Lavandula pedunculata* and related species)	Rosmaniric acid	Antioxidant, anti-carcinogenic, lowers blood lipid's level and acts as neuroprotective agent;	Phenolic fraction dominated by flavonoids and phenolic acids;
Thyme (mainly leaves of *Thymus vulgaris*)	Thymol; rosmaniric acid; caffeic acid	Antioxidant, anti-bacterial and anti-fungic activities, prevent atherosclerosis and has some anti-neoplastic action;	Rich in terpenes and flavonoids;
Spearmint (*Mentha spicata*) and peppermint (*Mentha piperita*)	Menthol	Antioxidant, antimicrobial, anti-inflammatory actions, neuroprotective, cardiovascular and antitumor preventive properties;	Genus *Mentha* comprises 61 species, differing in composition, although all rich in polyphenols;
Lemon balm (*Mellissa officinallis and related species*)	Citronellal, bergamol	Antioxidant, anti-inflammatory, analgesic, anti-pyretic and platelet-inhibitory actions;	Rich in aldehydes, terpenes and phenols;
Basil (leaves of *Ocimum basilicum* and related species)	Eugenol, linalool	Antioxidant direct influence on vision, lowering the risk of age-related cataracts;	Rich in carotenoids and xanthophylls; fairly rich in polyphenols;
Phennel (all plant *Foeniculum vulgare*)	p-Anisic acid	Antioxidant, anti-microbial and anti-diabetic actions;	Camphor and limonene are relevant terpenoids, while rosmarinic acid and luteolin are representative phenols;
Chilli-pepper (fruits of *Capsicum annuum*)	Capsaicin	Antioxidant, potentially beneficial in rheumatoid arthritis; analgesic and anti-inflammatory properties;	Various subspecies exist, in red, green and yellow colours; rich in the flavonoids luteolin and quercetin Capsaicin is the pungent compound ranging from 0. 1 to 1% and a bioactive molecule;
Cinnamon (from *Cinnamomum verum*)	Cinnamaldehyde	Antioxidant, anti-microbial Vasodilation and hypoglycaemic actions; helps control type II diabetes and hypertension;	Phenolic acids predominate in the phenolic fraction;

*Original table with information retrieved from: National Center for Biotechnology Information. PubChem Database (*https://pubchem.ncbi.nlm.nih.gov/compound/*), Phenol-Explorer 3.6 (*http://phenol-explorer.eu/*), and scientific literature*

Seasonings contribute to the flavour of dishes easily building up a complex "bouquet" in simple foods, while allowing to decrease the quantity of salt and sugar and their contribution of dietary phytochemicals should not be neglected. In some cases (e.g. basil), the amount used in cooking is such that is difficult to categorize it as a seasoning or as an ingredient; in other cases (e.g. cloves), the concentration in active phytochemicals is so high that a fair supply of bioactive compounds to the diet is ensured, even if the spice is used in minor quantities. As can be noticed in Table II, antioxidant properties are reported for all listed herbs and spices, a feature that is due to the presence of polyphenols (see above).

Regarding Mediterranean culinary, in short and just as an example, it should be noted that a basic cooking procedure in starting many traditional dishes consists in heating chopped onion and garlic in a small volume of olive oil, to which tomato is often added. Chemically, the olive oil constituents (not only the oleic acid) synergistically act in releasing and enhancing the bioavailability of allicin and lycopene, which are health-promoting phytochemicals respectively from onion and garlic, and from tomato[28]. That basic step, which also releases flavours, can give rise to a sauce, to a risotto or to a stew, depending on the next ingredients and seasonings, and in a few minutes, a balanced, colourful and aromatic meal will be ready.

Reviewing herein the health benefits of all components of Med diet would be too extensive and maybe tiresome for the reader, as would be the detail of cooking methods and related chemical processes. Moreover, food habits are interlinked with cultural factors such as social habits, rituals and traditions that bring cohesion and motivation to follow Med diet, certainly contributing to individual wellness as well as to regional wealth.

3.2. SOCIAL AND ENVIRONMENTAL BENEFITS

"Sustainable diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources" (FAO, 2010, Sustainable Diets and Biodiversity)

The MD has a strong cultural dimension rooted in the optimization of natural and human resources, it is respectful of the environment by embracing biodiversity and by privileging sustainable production systems. Med diet is one of the healthier diets in the world, providing a wide range of nutrients and other health-promoting compounds, affordably. It is also beneficial to local economies and the environment by highlighting seasonality and local cultivars and breeds, resulting in short distribution circuits that cause lower environmental impact than most other diets (mainly by saving energy in transport and refrigeration).

In order to meet the SGD and to guide the necessary changes in the food systems, methodologies and metrics have been developed to assess environmental impacts. The most consensual and well-known metrics is the quantification of GHG emissions (from human activities) in carbon dioxide mass - CO_2 eq.

Currently, the most consensual methodology to assess the environmental impact of a product (food, crafts, tools) is the Life Cycle Assessment methodology (LCA), an internationally recognized way to account the inputs, outputs and environmental impacts of a production system, namely of a food production system. The LCA is a holistic approach, which phases, units etc. are standardized by the International Standards Organization (ISO). When applied to foods, the boundaries of the system are clearly defined, and the inventory phase includes the processing steps, raw materials, mass balances, transportation etc. The analysis combines multiple indicators

28 Lycopene is a carotenoid to which health benefits are associated (https://lpi.oregonstate.edu/mic/dietary-factors/phytochemicals/carotenoids)

assessed along the production-consumption cycle, as energy and water consumptions, GHG emissions, and eutrophication and acidification potential[29]. This tool is currently in use in France in guiding product eco-design[30], and a similar approach may be of use in the Mediterranean area, to guide innovation in the framework of the MD (which traditional products evolved in making the best use of available resources).

At another level, the sustainability of diets in under the spotlights, and **a set of indicators have been consensually adopted.** Such **harmonized indicators for assessing sustainable food systems are of three categories: Nutritional and Health indicators (encompassing diet-related morbidity/ mortality, nutrient adequacy ratios, nutritional anthropometry, etc.); Environmental indicators (carbon footprint, rate of regional foods and seasonality, agrobiodiversity, land use, etc.), and Socio-Economic Indicators (income, wealth and equity).** Researchers and Think Tanks are currently focused in their perfection and aptness, using Med diet as a case-study, aiming at addressing SGDs and the 2030 agenda (at this respect, please recall footnote 8).

It is consensual that the current paradigm has to change, and that Med diet is an adequate model for such change, but ongoing works show the complex reality as for the choices and challenges, as disclosed in Fig. 5, the double pyramid model.

The model in Fig. 5 shows that fruits and vegetables are simultaneously good for health and for the environment, as they are placed at the base of both pyramids, in the green zone. Red meat is placed on the top of both pyramids, in the red zone, meaning its abuse is deleterious for health and the environment, and hence it should be consumed in very small amounts. The intermediate levels of the pyramids may somehow diverge, for example in relation to sweetened foods, which environmental impact is low, while its regular consumption is deleterious for health; identical situation occurs with the fish and olive oil, which regular intake is nutritionally important, despite the less favourable estimated value of environmental impact.

Sustainable food systems are of capital importance in adequately feeding a growing human population, as translated in SGD 2. On the other hand, the energy and transportation sectors have the worst environmental performances and hence the largest impact on climate change, highly above the cattle. However, food production makes use of energy and transportation, which means that less energy-demanding food production should be targeted (e.g. stimulating seasonality, thus reducing greenhouse production and refrigeration storage), as well as local consumption, whenever possible, thus cutting costs and GHG emissions from transportation. These aspects may also become relevant in crisis, when food sovereignty and resilience can make real difference.

29 Finnegan W, Yan M, Holden NM et al. (2018) Int J Life Cycle Assess 23:1773. https://doi.org/10.1007/s11367-017-1407-7
30 www.ademe.fr/eco-conception

Environmental pyramid

Food pyramid

***Figure 5**. The Double Pyramid model. Adapted from: Ruini LF, Ciati R, Pratesi CA, Marino M, Principato L, Vannuzzi E. (2015) Working toward Healthy and Sustainable Diets: The "Double Pyramid Model" Developed by the Barilla Center for Food and Nutrition to Raise Awareness about the Environmental and Nutritional Impact of Foods. Front Nutr. 2:9. doi:10.3389/fnut.2015.00009.*

Despite some vegan diets appear environmentally friendly and trendy, they may not be that sustainable after all - e.g. when ultra-processed foods are part of the menu, or when such diets require ingredients high in food miles, and nutritional supplements (which environmental footprint is generally disregarded). From the nutritional point of view, certain vegan diets may lack or not adequately supply certain nutrients. That is the case of essential aminoacids (lysine, threonine, methionine, and tryptophan), which are absent or present in very small amounts in plants. Moreover, although plants contain vitamin precursors, the bioavailability of certain vitamins – notably A, D, E, K - is higher in animal-based foods, where they are associated to the fat fraction, given their hydrophobic nature.

In addition, some important fatty acids of high bioavailability (known as CLA) which act as precursors in hormone synthesis, are abundant in ruminant's meat and dairy. Despite such compounds can be synthesized from alfa-linolenic acid (ALA) that is present in olive oil, however, in terms of nutritional security, the Mediterranean way is balanced by prescribing modest intake of (small) ruminant's meat and dairy. On the other hand, such protein being obtained from animals that are fed from plant materials (e.g. cellulose) that cannot be digested by humans, bringing a positive net effect on human food provision, on optimizing resources, given that sustainability is observed. The interdependence between agricultural and wild biodiversity should be noted[31], as it is enclosed in the Mediterranean Diet concept.

Producing enough food to meet the nutritional requirements of a growing population in a sustainable manner is enough for a challenge, and that will mean environmental impacts will be reduced as well (as deduced from the rough alignment of both pyramids from Fig. 5). Changing food habits with the aim at decreasing environmental impacts may not be as effective as

31 https://www.bioversityinternational.org/news/detail/integrating-wild-and-agricultural-biodiversity-conservation-why-we-need-both/

expected, because current state-of-the-art metrics still lack precision and the risk of nutrition insecurity/inadequate diets can be high.

In short, the Med diet is a benchmark for nutrition and sustainability because traditional Mediterranean foods are healthy and respectful of the biodiversity and the environment, in accordance to FAO's definition of sustainable diets presented at the top of this section.

Adhering to the Med diet allows for the individual contribution to sustainable food consumption, as most Mediterranean dishes are easy to cook, delicious, good for the planet, and good for human health

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In what concerns sustainable food production, the MD has the potential to create wellness and regional growth through sustainable innovation, especially nowadays that IT technologies (namely AI and IOT) are so accessible. **Requirements for high quality standards, proximity circuits, food traceability, work conditions for the producers, as well as reduced environmental impact should all be closely observed** when creating innovative foods within the MD framework, namely by using appropriate eco-design methodology and tools.

4. PRODUCTS

Even with the geographical and religious differences, the Med diet is shaped by the same features in both sides of the Mediterranean basin, rooted on resilience and optimization of resources trough millenary wisdom. The common products that shape Med diet are presented in the section below.

4.1. MEDITERRANEAN PRODUCTS

Olive oil **is the main fat used as cooking ingredient (in practically all dishes, including some desserts) as well as dressing for salads and greens (Fig. 6).** There is much more in olive oil than the right balance of fatty acids, as referred above (in section 3.1) and additional information on the grading and designations of olive oils is available from International Olive Council[32]

Olive oil has been regarded as the cement of the Med diet, thus it seems pertinent to snapshot the current situation in the Mediterranean countries, in respect to national average intakes of olive oil. According to a report of the IOC published in 2015, the Greeks top the world rankings with an average daily per capita intake of about 46 mL/capita. Spain followed with around 30 mL/day, Italy with 27 mL/day and Portugal with about 21 mL/day. Cyprus' national average olive oil consumption is about 16 mL/day (slightly below the level that may correspond to health

[32] International Olive Council. Designations and definitions of olive oils: https://www.internationaloliveoil.org/olive-world/olive-oil/

benefits – see 3.1). Croatia's average olive oil consumption is much lower (4–5 mL/day) but higher than Slovenia (with about 2 mL), although in both cases, food habits in coastal regions may differ from those in inlands. In Romania, Bulgaria and Bosnia-Herzegovina, the average national consumption of olive oil is negligible (less than 1 mL/day), meaning that even at the coastal regions, the usage of olive oil to cook and season foods is probably less than modest (Issaoui and Delgado, 2019).

Figure 6. Olive oil bottle with mature and unripe olives (Photo by Roberta Sorge on Unsplash)

Another olive product is the table olive, obtained from olive varieties poorer in oil (but rich in fibre, vitamins, minerals and anti-oxidants), for which many traditional preparations styles and recipes exist, generally involving a fermentation process, and resulting in a nutritious and versatile food[33]. Many table olive cultivars have been abandoned and face the risk of extinction, despite such trees are able to take the best advantage of poor soils, drought and other harsh conditions to produce a nutritive healthy food.

Cereals, notably wheat (coarsely milled) are another pillar of the Med diet. The selection of most adequate wheat varieties and the ability to make bread (involving fermenting and baking the dough) was a turnkey in human population growth, because wheat bread supplied some protein (about 8%) and B vitamins, in addition to the energy from carbohydrates. Such complex composition dramatically improved the quality of human diet and probably our civilization would not thrive without the steady availability of bread, including the contribution of gluten to the protein intake.

Besides bread, wheat is also used to make pasta and couscous, leading to the selection of different wheat varieties to suit such different applications, and thus contributing to increase agrobiodiversity. Mediterranean peoples, with their resilience and resourcefulness, have been using other cereals to make bread, namely corn and rye (alone or blended with wheat).

[33] For more information on table olives please see: https://interaceituna.com/la-aceituna-de-mesa/#dieta_mediterranea

The introduction and adaptation of rice, namely in wetlands of Portugal and Italy, should also be noted, as rice is the base for many traditional Mediterranean dishes, such as risotto and paella.

In times of scarcity, other starchy plants were also used as energy supply, as is the case of corn that has been used to prepare a porridge, to which olive oil and other ingredients are added; Another example is the obtainment of flour from carob pods (which are dry and easily grinded) to blend with wheat flour in making carob's bread, once viewed as a famine food. Currently, the revamped use of carob flour in bakery has been successful, displaying an increasing trend in demand.

Still regarding sustainability, it should be noted, that Med diet encloses the wisdom to fight food insecurity, including in the many culinary recipes to tackle food waste, showing how it can be cleverly mitigated – e.g. dry bread is ideal to make "gazpacho" or "açorda" (highly appreciated bread-based dishes).

Vegetables and fruits of the season consumed in large quantities and in variety is a key feature of the Med diet, once again linked to agrobiodiversity. The Mediterranean basin harbours an enormous number of different fruits and vegetables, which maturation occurs sequentially along the seasons of the year. As referred before, fruit trees have been cultivated in marginal lands and near the houses, incredibly augmenting the genetic variation along time, as noted in legends of Fig. 1 and 7.

The food industry, despite once encouraged standardization with the consequent abandonment of local cultivars, has nowadays an opportunity, in the new paradigm, of innovating to decrease food waste and ensure healthy and nutritional foods for all, in compliance to SGD 2 and 13.

Figure 7. *Grapes, a ubiquitous fruit in the Mediterranean where a myriad of cultivars can be found (source: Cyprus Tourism Organization Archive, Photographer Michalis Georgiades)*

Herbs and spices abundantly used in cooking and seasoning are not only tasty (by the aromas conveyed) but also healthy, by allowing reducing the amount of salt in foods and by the relevant supply of dietary phytochemicals (as detailed in table II above). Given the used quantities, it is sometimes difficult to distinguish if an herb is being used as a condiment or as an ingredient. Such culinary herbs include different types of mints, parsley, coriander, oregano, rosemary, basil, chilli-pepper, and many others some of which are gathered in the wild. The biodiversity of culinary herbs is such that many distinct species and subspecies are known by the same English name (e.g. basil,

mint and rosemary). At most Mediterranean regions aromatic herbs can be easily at hand in the kitchen garden, even if nowadays they are generally available in the retail market, where spices as cloves, cumin, saffron, pepper or nutmeg can also be found. Each local cuisine is coined by the aromas conveyed by locally available herbs and spices, which most probably vary from region to region (even if classified in the same species). **As aromas are mostly secondary metabolites of plants, they are expected to vary with many factors as the soil, climate, agricultural practices, season, etc.** In short, a common list of (mostly autochthone) herbs and spices which are typical of Med diet can be identified, conveying the health benefits listed in section 3.1. However, at a lower scale level, that is, when speaking of local cuisines within a region, differences can be identified, due to local preferences and availability does impacting the aroma of dishes and resulting in a multitude of "Mediterranean regional cuisines", again the "unity in diversity" applies to the Med diet.

Pulses **are plants in the *Fabaceae* family that produce the seeds in pods and such seeds and/or pods may be of three types: those richer in complex carbohydrates (e.g. carob), those richer in oil (e.g. soy) and those richer in protein (e.g. bean, chickpea).** Pulses are in this last category and are important in sustainable agricultural systems for their ability to fixate nitrogen from the atmosphere to the soils.

Carob pods' flour has been giving a valuable contribution to the diet, namely in supplying fibres and complex carbohydrates, and its use in bakery was recently successfully revamped at Algarve, Portugal. On the other hand, pulses (protein-rich seeds of edible Fabaceae) are no doubt of highest interest: UN declared 2016 the International Year of Pulses[34], and FAO raised awareness on their use in multiple campaigns. **In Med diet, pulses have been playing a relevant role as protein sources, being included in many dishes from the culinary tradition** of regions participating in MD-net project. Such seeds have a low moisture content, excellent preservation characteristics and high levels of protein and fibres. **Besides the protein (20-25% dry weight of edible portion), pulses supply fibres and complex carbohydrates (10-25%) as well as oligosaccharides (3-5%) beneficial to gut's health, vitamins and minerals. Pulses are rich in a variety of polyphenols which convey anti-inflammatory, anti-diabetic, and anti-carcinogenic activities.** In addition, some phytosterols present in pulses (namely in lentils and chickpeas) have been reported to lower cholesterol levels in blood (Delgado et al., 2019). An enormous agrobiodiversity of beans, broad beans, chickpeas, peas and lentils can be found in the area and some Mediterranean pulses are valued by quality logos of geographical indication (e.g. Fesols de Santa Pau PDO, Fava Santorinis PDO).

Animal protein sources **were once scarce resources and hence consumed in very small amounts, except in festivities, when restrictions were overlooked. It is noteworthy that, for the reasons explained in module 1, the high consumption of red meat is not a traditionally feature of the Med diet,** because the Mediterranean region is more adequate to small ruminants, chicken and pig (when considering sustainable extensive systems). Cows in Southern Europe, and Camels in North Africa were traditionally mainly used for labour – in the transportation of loads and/or as driving force in tillage works etc.

In Southern Europe, especially at the isolated villages in the hills, pork and chicken were preferred types of meat, although consumed with parsimony. Pork meat is easily preserved – in some

34 International Year of Pulses: http://www.fao.org/pulses-2016/en/

regions the pork legs are submitted to a curing procedure to manufacture ham, and some of them hold quality seals attesting its regional features. Chopped meats from other parts of the animal after seasoned with abundant paprika, herbs and spices are packed in the intestines of the animal and smoke-cured to result in a diversity of chouriço/chorizo, salami and other pork preserves. Even the blood is preserved by blending it with some minced meat and fat and adding other ingredients and seasonings, following ancient regional recipes; instead of food waste sensorially and nutritionally distinct foodstuffs are obtained instead (Fig. 9A). Some of these preserves are worldwide famous, often taking the English designation of sausages and ham, which may be misleading, as Mediterranean pork preserves are much drier and contain many more seasonings and spices, than the commonly recognized sausages and hams. Despite Mediterranean pork meat's preserves are categorized as processed meats, when consumed in small amounts they should not present a health risk[35] but rather a valuable nutritional resource, since they are mainly used as a seasoning, conveying flavours to plant-based dishes, notably the "umami" flavour.

Pork is forbidden by the Islam but, for Christians, it was regarded as a valuable resource in rural isolated communities: one pork supporting a large family through the year, supplemented with a few eggs, a couple of chickens and some fish preserves.

In many eastern European villages, when the pork was killed, at a chosen timing according to the season and to the phases of the moon, it was an occasion for a communal celebration, an occasion to taste the fresh meat, while preparing the rest of the carcass for preservation, in a minimum-waste approach.

When fresh meat and fish are consumed, the preference goes to white meat (e.g. poultry) and fishes such as sardine and tuna, rich in n-3 poly-unsaturated fatty acids (commonly known as omega 3 fats). Fig. 8 shows grilled sardines, a traditional summer delicacy in Portugal, typical of the June celebrations. Nowadays, sardines have been included in the list of endangered species due to overfishing[36]. The issue of severe fishing restrictions to sardine will be hopefully soon overcome, since the developments in sardine farming at Algarve are encouraging[37].

Figure 8. Grilled sardines, a fish that is rich in n-3 fatty acids, typically consumed during summertime notably in Portugal (Photo by the author)

35 On processed meats and cancer risk:
http://www.europarl.europa.eu/RegData/etudes/ATAG/2015/571308/EPRS_ATA(2015)571308_EN.pdf
36 https://www.reuters.com/investigates/special-report/ocean-shock-sardines/
37 https://www.sulinformacao.pt/2019/02/sardinhas-nascidas-em-piscicultura-do-ipma-ja-tem-tamanho-para-ir-para-a-grelha/

At the coastal areas, a wide array of fish and seafood is available through the year, being the fishing of each species also seasonal and depending on the weather conditions at the sea.

If in the inlands, pork preserves ensured the availability of meat along the year, likewise near the seaside fishermen preserved fish, by salting and drying, with the same purpose. Some of these fish preserves are nowadays regional delicacies, as salted sardine in Croatia, salted anchovies in Italy, dry salted fish in Iberian Peninsula, and other regions of the Mediterranean, or Tuna preserves, notably "Muxama" and "Estupeta" from Algarve, Portugal. According to Mediterranean way of life, with no place to wastage, the tuna meat unsuitable for "Muxama" were used to prepare "Estupeta" (Fig. 9B).

Figure 9 shows two traditional products made of marginal meat (small pieces of muscle, organs, blood) allowing the minimization of food waste, while ensuring (just) the necessary amount of animal-based protein. It is noteworthy that, despite plants are excellent sources of protein they often lack or contain minimal amounts of some essential aminoacids: lysine, threonine, methionine, and tryptophan. Since human metabolism cannot synthesize these amino acids, it is recommended to obtain them from animal protein sources due to their higher bioavailability.

It is also noteworthy, that wild snails (nowadays farmed) have been a valuable resource of Mediterranean peoples, turned today of an appreciated delicacy, cooked as a snack (e.g. caracóis à Algarvia) or as part of a dish in Spain and Greece, where many different recipes exist.

A B

Figure 9. Examples of a meat preserve (A) and a fish preserve (B) from the Mediterranean region, obtained by traditional methods. A, on the left: "morcela de carne de Monchique" (main ingredients are pork blood, minced meat and lard) a meat preserve manufactured with side products of traditional pork killing. On the right, B: "estupeta" refers to an analogue situation for a fish preserve – the parts of the tuna fish not suitable for other purposes are washed, salt-dried and brined. Both of these preserves aims to be consumed in small quantities in stews and salads. In the case of salted products, a previous soaking step is observed before use (source: Produtos Tradicionais Portugueses, Lisboa, DGDR, 2001)

Another relevant peculiarity about animal protein sources is that two of the most appreciated dairy products, cheese and yogurt, are originated from the Mediterranean, where they have been

manufactured with the milk of small ruminants, which composition may significantly differ from that of bovine's milk (Halima et al, 2015). Milk from goat, sheep, buffalo and camel (pseudo-ruminant) of regionally adapted breeds, has been traditionally consumed in the region and most used for cheese making. In the case of cheeses, most manufacture processes have been preserved, while the manufacture of yogurt was adapted to bovine's milk, the process was optimized and standardized, and yogurt is nowadays mostly a global product from a couple food corporations. On the other hand, today's main driver to preserve local breeds of small ruminants is the need of their milk to manufacture valuable cheeses.

Yogurt and cheese are interesting protein sources, because, in addition to their high nutritional value, they may convey probiotics and other health benefits (common to fermented foods). Finally, it is noteworthy that the environmental impact of dairy products, when calculated by comprehensive consensual methodologies (as LCA)[38], can be surprisingly low. The explanation may rely in the fact that most of the environmental burden if charged to the animal (as direct GHG emissions and feed) and cannot be charged twice. In addition, a ruminant produces many litres of milk along its life, and only the factors intrinsic to the dairy products are accountable. Sustainability aspects were discussed in section 3.2.

Many simple ancient recipes are based in the flavouring of dishes with traditional fish or meat preserves, and in their seasoning with aromatic herbs and spices, thus dramatically reducing the use of fresh fish or meat, in an enjoyable way. Salads with cheese are part of the Mediterranean menu, as well as many vegetarian (ovo-lactic) recipes: herein, plant-based proteins (e.g. beans or peas) compensate for the reduced intake of fresh meat and fish, or, as alternative, sustainable animal proteins (e.g. cheese and eggs) may replace fresh meat and fish and complemented (if necessary) with plant-based proteins.

Nuts and dry fruits are preferred snacks, providing a wide range of nutrients and ensuring satiety in small portions, contrarily to the common industrial snacks that are high in calories, high in salt/sugar and usually contain flavour enhancers to stimulate the appetite. Nuts are fruits comprising a hard shell and a seed and can be found in a wide variety of genera. Herein, the term 'nut' should be regarded in the culinary sense, as it includes both, fruits and seeds, when considering the botanical classification. Native nuts from the Mediterranean region include walnuts (from *Juglans regia*), hazelnuts (from *Corylus avellana*), chestnuts (from *Castanea sativa*), almonds (from *Prunus dulcis*), pistachio (from *Pistacia vera*) and pine nuts (from *Pinus pinea*). The kernel of the seed usually constitutes the edible portion. Traditionally, in the Mediterranean basin, nuts have been mostly consumed raw or used to stuff dry figs or dates, appreciated appetizer and snacks. As referred above nuts convey important health benefits, some of them officially recognized as health and nutritional claims.

Different types of nuts are relevant ingredients in a traditional desserts and pastries (Fig. 10), along with dry figs and dates, or are just eaten together.

38 LCA, stands for Life Cycle Assessment, a methodology that examines a large number of indicators, along the production, processing, and distribution of a food when assessing sustainability

Figure 10. Examples of a traditional pastry and a sweet snack (from Algarve, Portugal) both including almonds; once typically reserved for festivities, they can be widely found nowadays (although of widely variable quality). (Photo by the author, on the left, and by D.C.D. DRAPAlgarve, on the right)

4.2. INTERNATIONAL QUALITY LOGOS AND OTHER ALLEGATIONS

Official and private organizations may issue product certification procedures, eventually with a corresponding seal of quality, generally aiming at transmitting to the consumer some assessment about the superior quality or ethics-related features of the product. Today's consumer is exposed to a panoply of labels on food packages that he/she would just quickly glance at, the same way as for the advertisement messages. **It is thus important to raise awareness on the existing quality seals and schemes, namely those granted by the European Community as certifications for Geographical Indications (GI) and Organic/Bio foods.**

The first set of European quality seals – GI, link traditional knowledge on manufacture with biodiversity and peculiarities of a given territory. Such labels are geographical indications of origin that are recognized as intellectual property and play an important role in trade. GIs, PDOs and PGIs protect the name of a product, which is from a specific region and follows a specific traditional production process. With PDO having the strongest link to the region, with every part of the production, processing and preparation process obliged to take place in the specific region[39].

These EU quality schemes are granted by European Commission's Food, Farming and Fisheries department. The preparation of the application and quality supervision is of the responsibility of local organizations, observing European legislation, which also explains how to use the logos in relation to each scheme, how the schemes should be applied, and covers the labelling guidelines for agri-food products which use PDOs or PGIs as ingredients.

A

B

C

39 https://ec.europa.eu/info/food-farming-fisheries/food-safety-and-quality/certification/quality-labels/quality-schemes-explained_en

Figure 11. Logos corresponding to the EU Quality Schemes: Protected Designation of Origin - PDO (A), Protected Geographical Indication - PGI (B), and Traditional Specialty Guaranteed - TSG (C), which are considered as Intellectual property under a specific legal framework. The GI recognition enables consumers to trust and to distinguish quality foods while also helping producers to market their products better.

Product names registered as *Protected Designation of Origin* (PDO) are those that have the strongest links to the place in which they are made, and to hold the logo A, from Fig. 11, every part of the production, processing and preparation process must take place in the specific region.

Product names registered as *Protected Geographical Indication* (PGI) show a particular quality, reputation or other characteristic that is essentially attributable to its geographical origin, and to hold the logo B, from Fig. 11, at least one of the stages of production, processing or preparation takes place in the region.

*Traditional Specialty Guaranteed (*TSG) means that traditional know-how on the product is protected, such as the way the product is made or its composition, without being linked to a specific geographical area. The product can be manufactured outside the region given its characteristics are guaranteed. TSG protects the product against falsification and misuse.

A search in the EC database for EU geographical indications register[40] was undertaken by the end of 2019, aiming an overview of Indicative traditional Mediterranean food in the countries to which belong the participant regions in the MD.net project. Consequently, the traditional foods: "olive oil", "endemic plant crops", "pork preserves" and "cheeses from small ruminants' milk" - were searched in the corresponding food categories of the above-mentioned European database of food quality labels (wine was not considered because, in 2019, followed different quality schemes).

Olive oil and wine are produced in all of the herein analysed countries, although to different extent. The above-mentioned quality schemes and intellectual property protection have been applied to traditional Mediterranean products, also to different extent by the different countries. Thus, as much distinct foods within a category exist in a given country, as higher the probability of retrieving GI registries. The opposite is also plausible: if the number of foods from a given category is low or inexistent, then an absence of GI registries for that food category is most probable.

As shown, in table 3, Spain, Italy and Portugal have entries in the database corresponding to the targeted traditional foods from all searched categories, with long lists from Spain and Italy.

Table III – Existing (X) and Non-existing (-) typical Mediterranean food products holding an EC Geographical Indication label (PDO or PGI), in each MED.net participating country

	Country								
Foods granted with GI (EC)	*AL*	*BA*	*CY*	*ES*	*GR/EL*	*HR*	*IT*	*PT*	*SI*

40 https://ec.europa.eu/info/food-farming-fisheries/food-safety-and-quality/certification/quality-labels/geographical-indications-register/#

Olive oil (in oils and fats)	-	-	-	X	X	X	X	X	X
Endemic fruit or vegetables (in fruits, vegetable and cereals)	-	-	X*	X	X	X	X	X	X*
Pork preserves (in animal products)	-	-	X	X	-	X	X	X	X
Cheeses from small ruminants (in cheeses)	-	-	-	X	X	-	X	X	X

Name of countries are abbreviated according to ISO 3166 alpha 2 country code, as listed in https://www.iban.com/country-codes;

In the first column, discriminated typical foods are followed by the corresponding food categories in which they are included, between brackets

***not typically Mediterranean*

In what concerns olive products, it should be noted that the list of Greek olive oils and table olives, holding geographical indications, is remarkably long, denoting the preservation of agrobiodiversity in this sector. Italy also has a high number of GI entries protecting their outstanding olive oils varieties.

In respect to endemic cultivars of fruits and vegetables, GI registries for such crops are retrieved from Spain, Greece, Croatia, Italy and Portugal. In this category, the highest numbers of entries are from Italy and Greece and the smallest number of entries are from Croatia.

Greece apparently do not have any GI for pork preserves, which does not correspond to the relevance of pork in Greek's food balance. Identical situation is observed with goat's cheeses from Cyprus, which names and indications of origin do not seem to be protected. Any GI registry was found for Croatian cheese from small ruminants, despite goat and sheep cheeses from Croatia are reported.

Finally, no Geographical Indications were found for any of the selected traditional Mediterranean foods (olive oil, endemic fruits and vegetables, pork preserves, cheese from small ruminants) from Albania (AL) or Bosnia-Herzegovina (BA), contrarily to the other Balkan countries, Croatia (HR) and Slovenia (SL), which adhesion date to the EU, despite recent, was not significantly different.

Another important certification scheme in line with the Mediterranean Diet is the Organic Food Certification. European organic production means a sustainable agricultural system respectful of the environment and animal welfare, also including all other stages of the food supply chain. In order to display the label shown in Fig. 12, farmers and food processors need to comply with a set of rules, encompassing: crop rotation for an efficient use of resources; no chemical pesticides or synthetic fertilizers; very strict limits to livestock antibiotics; no genetically modified organisms (GMOs); use of on-site resources for natural fertilizers and animal feed; raising livestock in a free-range, open-air environment and the use of organic fodder; tailored animal husbandry practices.

Figure 12. EU organic logo.

To display the logo of Fig. 12, producers need to regularly ensure the compliance with EU rules on organic production, but also receive financial and technical support, including access to ongoing R&D efforts aiming at increasing productivity and quality of European organic food products[41].

The market of organic foods is expanding, both internally to the EU (main consumer countries are France and Germany) and externally (to USA, Canada and China). From 2012 to 2016, the sales of EU's organic market increased 47.7% and the organic farmland increased 18.7%.

Other common logos, mainly displayed in processed packed foods, are related to fair trade, to the protection of rainforests, sustainable fishing, dolphins' protection, etc. At EU level food labelling is mainly regulated by Reg. (EU) No 1169/2011.

Researchers from EUFIC observed that nutritional information was mostly disregarded, with the nutriscore/nutritional facts and list of nutrients being most appreciated by consumers already following a healthy eating pattern. The study found no evidence that changes in food labelling may prompt consumers to make healthier food choices in real life. Researchers suggested giving the consumers a task instead (e.g. `reduce your salt intake')[42], thus highlighting **the importance on educating the consumers to make healthier food choices – in this case, educating Mediterranean natives to improve their adherence to the Med diet.**

5. FOOD TRADITIONS AND GASTRONOMY IN THE MEDITERRANEAN

Mediterranean traditional festivities are aligned with the pace of nature, noting the solstices and moon cycles. Some festivities are of religious nature; others blend religious roots with non-religious practices or are based on ancient pagan celebrations. **Recently some contemporary festivals have been integrating the list.**

In the spring, the most prominent and common celebration, in the Christian part of the Mediterranean, is Easter, which may involve processions along the streets and elaborated meals starring the lamb dishes – for their biblical origin, ending-up with egg-based desserts, an

41 EC, becoming an organic farmer: https://ec.europa.eu/info/food-farming-fisheries/farming/organic-farming/becoming-organic-farmer#certification ;
R&D and innovation for the food sector: https://eit.europa.eu/our-communities/eit-food
42 Hieke S & Wills JM (2012). Nutrition labelling – is it effective in encouraging healthy eating? CAB Reviews 7(31):1-7.

expression of nature's rebirth and blossoming. The Orthodox Easter is celebrated in Greece and Cyprus in slightly different dates from the catholic Easter, while in the Balkans both dates may be celebrated. Each country blends the common religious rituals with its own secular customs, from lighting bonfires in Croatia, to spraying young girls with perfume in Serbia, to passing under the table in Romania. The common elements of safeguarding cultural aspects of ancient practices are closely linked with convivial meals involving the enlarged family.

In May, In Morocco, the Festival of Roses is dedicated to commemorating the season's rose harvest. It is held at a place known by Valley of Roses, where it is produced most of the Moroccan rose water, a staple in Middle Eastern cooking and folk medicine. The festival's date depends on rose's harvest.

Still in May, Kataklysmos, meaning flood, is a popular festival celebrated in Cyprus and Greece that carries religious undertones, as it comes from the Biblical tale of Noah's flood. It is nowadays celebrated with water games, folklore dances and traditional arts. Elsewhere, namely at Algarve, Portugal, ancient pagan celebrations related to harvest's abundance have been revamped into attractive local cultural festivals.

In summertime, festivities occur at open air, often the streets are decorated, and people enjoy the warm weather, music and dancing, as well as specialty food of the season – a splendid variety of fruits, vegetables and seafood. Markets showcasing traditional food and crafts, and communal meals are frequent elements at these festivities.

In June, all over the Iberian Peninsula and Italia celebrations in honour of Christian saints, also integrating other cultural elements, invade the plazas and patios with music, decorations and lights, fairs and carnivals bringing the people outside until late at night, and attracting the attention of the tourists from outside the Mediterranean. Again, foods of the season are an integer part of such celebrations.

In August, in the peak of summer, each Christian community, from the small fishermen communities to the isolated villages in the hills, has its own festivities, in honour of Our Lady. Such celebrations probably originated from *Feriae Augusti*, the festival of Emperor Augustus meant as a period of rest after the hard-labour period in the agricultural sector, and later merged with religious celebrations. Again, processions, markets, outdoors' festivals, and communal events and meals, mark the dates. The culinary traditions highlight the products of the season and the special cakes and desserts.

Christmas is the dominant celebration in winter, a festivity that takes place mainly indoors with the (enlarged) family, as the weather is generally rainy and colder. Christmas culinary traditions highly vary in details from region to region, although the common features are the richness, abundancy and laborious preparation of dishes, contrasting with regular daily cuisine. Even in poorer homes, Christmas meals are richer than usually. The enlarged family gathers to prepare special traditional dishes that include abundant meat, dry fruits and nuts, and special desserts.

As with other cultural features, also the culinary is part of the common heritage of the Mediterranean peoples, although varied across Mediterranean regions it is rooted in the same historical influences, population fluxes and trades. In other words, Mediterranean cuisine is widely diversified, with place to regional variations that optimize endemism and seasonality yet grounded on common principles and sharing culinary features and ingredients. It is simple yet exquisite, rooted in the balance of nutritional excellence while respectful of nature.

When broadly examined, Mediterranean culinary heritage shares the features presented in section 2. while making use of the products presented in 4.1., yet showing regional features, when

analysed at a lower level. The local cuisines are most often balanced with ingredients from the sea and from the inlands exchanged in local markets that evolved into occasions of direct contact between farmers and urban consumers. Such revamped local fresh food trades may become important to ensure the independence from external markets during crisis and in improving sustainability (by reducing food miles), while observing international rules.

6. SWOT ANALYSIS AND CONCLUDING REMARKS

The above overview, on Mediterranean culinary traditions, discloses the relevance and magnitude of such cultural heritage in which the local cuisines coin the diversity angle of the Med diet, which is a key feature in preserving biodiversity and regional culture, a cornerstone of the Mediterranean Diet.

Such "unity in diversity" can be detected even within a certain region, comparing local recipes and habits from seaside to inlands, from village to village, with variations of the same magnitude as those observed between different countries. The opposite is also true: that is, peculiarities are shared by distant regions (e.g. snails are delicacies at Crete, as well as at Algarve), as well as the simple ways of cooking yet including a long list of ingredients and seasonings, and most notably the balance of the food items in accordance to Fig. 3.

The following swot analysis compiles keywords and ideas supplied by the actors from the participant regions, in the project MD.net, regarding Tradition and Culture, Health, and to the Mediterranean products and dietary pattern

Strengths

The actors acknowledged that the high diversity of foods resulting from the diversity of landscapes not only build up rich regional gastronomies but also allows to further develop excellence and added value by the means of European quality schemes (intellectual property associated to geographical indications). Several participant regions already have a long list of registered PDO and PGI, which are recognized as valuable assets. These quality schemes may be drivers for the recovery and further sustainable exploitation of autochthone plant varieties, thus enhancing local culinary arts and cultures, reinforcing the adherence to the Med diet, positively impacting local economies.

The local agriculture is mainly characterized by its high diversification with many distinct products integrating the Mediterranean diet. Many of these products hold the potential to be highly valued, as happened with olive oil, wine and certain cheeses, because of their linkage to the Mediterranean Diet, which health outcomes are valued worldwide. The actors mentioned the awareness on the nutritional characteristics of this food pattern and the pride to live in Med culture as driving forces for development. The still existing traditional knowledges of culinary arts and crafts are more than enough to revamp the Med diet in improving the adherence to the Mediterranean food pattern and in reinforcing local economy through Intellectual property – linked to traditional products (retrieving biodiversity and improving quality specifications) or

linked to innovation in the framework of Med diet, depending on the selected strategy. The existence of important universities in some participating regions is a plus, given the access to know-how and high-level innovation in agriculture, as well as in food processing, food preservation and packaging, and in ICT. Other important stakeholders to the food systems and food supply chain are located in the Mediterranean (e.g. PRIMA, EFSA) which may facilitate their involvement in a regional high-tech network organized in a thematic agro-food platform.

Another noted feature is the existence of know-how and experience in protecting Mediterranean heritage, namely by giving the scientific support to health and nutritional claims, in the valorisation of traditional foods and lifestyles as well as in implementing an eco-sustainable approach to innovation. Moreover, Catalonia has the experience in dealing with different labels and quality seals and has a long history in the development of private and public quality programs in the field of the development, diffusion and protection of MD.

Such efforts are expected to be supported by the identified good national and international image of Mediterranean autochthone products and cooking.

Weaknesses

The small scale of farms and business along the food production sector, the lack of integration between producers and operators in the Med supply chains, have been identified as major problems; The shortage of autochthone raw materials was pointed out as a limitation for the growth of food processing to a global scale. However, the production of homogenous ultra-processed food has proven deleterious to human health and the environment and it is being replaced (e.g. in northern countries) by the retrieving of agrobiodiversity, organic produce and local markets. The need to better exploit the potential of the territory was referred, namely in bringing local products closer to consumers.

Interactions between farmers and urban customers have been promoted, namely in France and Switzerland, as well as in some Mediterranean regions aiming at reinforcing local markets and short-circuit distribution. The Mediterranean Diet already has such mechanisms still working, namely the periodical open air markets, just waiting to be revamped.

The need to expand the offer of gastronomic products and activities in the territory was referred, as well difficulties due to the limited scale of production of traditional food, including IGP. It is noteworthy that many products of limited availability (e.g. truffes, certain cheeses, wines and spices) are more than profitable, since the high demand rises the price. A suggestion was made, proposing new rules for traditional food that do not comply with European standards in order to strengthen local SME, while another actor called the attention that too many labels can be misleading and may kill the purposes of labelling and certification. The aim of quality labelling is to convey a message of quality related to a certain origin and a set of values, thus gaining the trust of the consumer while protecting a brand and an Intellectual property (e.g. European GI and organic logos).

Some project participants referred the competition between good quality Med food and low-quality cheaper products from developing countries, which can be a serious issue in low-income households (which generally have lower adherence scores to the Med diet, and higher incidence of obesity and nutritional deficiencies).

Eating well is not necessarily more expensive, as can be easily showed. However, approaching these segments of population, to raise awareness on food habits, may be harder due to their

educational level and literacy. At some regions awareness on Med diet is reported to be at an early stage.

A comprehensive communication strategy was suggested to be implemented to bridge the connections between the cultural sectors and the food and HORECA sectors, focusing in disseminating information about health and nutrition, as well as on food processing and culinary features in-line with Med diet. A reference framework and roadmap are referred as useful tools for the international promotion of brands and in obtaining recognition, and the different intervening agents and initiatives must be well coordinated.

Opportunities

International organizations acknowledged the main issues about global food systems, turning the spotlights on Med diet. Consumers' demand starts focusing on healthy, high quality sustainable food (zero miles).

The promotion of Med diet and lifestyle have contributed for the valorisation of traditional products, and young Chefs play a crucial role in valorising peculiar features linked to geoclimatic conditions. Many products hold the potential to increase their reputation on national and foreign markets, which can be facilitated by the growing interest of the academic sector in Med diet, and by the possibilities to increase promotion and dissemination of the Med diet (canteen meals, use of social media and apps) with the support of Public Administrations.

An increased trend on demand from foreign markets has been registered. Rising trends on exports have been reported in various regions, as well as a rising demand for gastronomy tourism.

As referred, there is a whole favourable context for the promotion and safeguard of Med diet, through educational activities, such as promoting food literacy and developing cooking skills among several groups, notably children. Some well-recognized culinary schools are already training their future professionals within this spirit of healthy eating.

Recent recorded interest of young people for agriculture and authentic food production can be the driver of new economic models based on self-employment of young educated entrepreneurs able to develop innovative businesses rooted in Med diet values

The possibility to move forward towards a recognition/certification of the Med gastronomic culture was referred as a current opportunity.

Threats

A progressive erosion of Mediterranean dietary model (through the replacement of local non-processed food with worse, cheaper, ultra-processed food) was perceived by participants in MD.net project and can be easily confirmed by national surveys and studies. The lowest values for the adherence scores to MD dietary pattern are found among youngsters. This cultural rupture with traditional food habits is a health threat to future generations. Low involvement of SME and media was reported to impair the safeguard of MD, while favouring globalized behaviours and the preference for fast food. Such deleterious trend is now acknowledged, which is a crucial step to control it.

Conflicting and misinformation about benefits and inconveniences of food components and dietary features is conveyed by marketing machines, mass media, and opinions from social media influencers. In the same line a myriad of alternative foods (mainly ultra-processed, as "free-of" food), along with the rise and fall of a huge number of trendy diets (e.g. paleo, alkaline) marketed by powerful brands, augments the confusion of the consumers, and disseminates confusing messages.

In some regions, the need for the creation of structures and occasions for direct contact between farmers and consumers (e.g. small convenience store or farmers' markets) was reported.

The need to unify and review the criteria that define the Med diet was reported. The objectives would be to define comprehensive quality criteria to be applied by countries, institutions, food industries, avoiding commercial banalization and misuse of the concept. The interlinkage of the health side of Med diet with other perspectives (e.g. culture) would reinforce the concept.

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