Bioactive compounds, also called phytocompounds as they are mainly of vegetable origin, are substances commonly taken with the daily diet [1,2]. Although they are not true nutrients, they are believed to be able to positively influence health, contributing to the prevention of different diseases, as they are capable of modulating biological activities and important physiological functions [3,4]. Among the best-known bioactive compounds present in plant matrices are: carotenoids, polyphenols and glucosinolates. Many effects are attributed to these compounds, such as antioxidant and anti-inflammatory activity, modulation of detoxification enzymes, stimulation of the immune system, modulation of hormonal metabolism, antibacterial and antiviral activities, antiproliferative activity [5]. The attention shown by the researchers for these compounds and the interesting and promising data that emerge from the research carried out, still deserve further investigations on the evidence acquired in order to clarify their role in health. All this is also in relation to the fact that the interest in knowing the specific functions of these compounds is accompanied by the development of so-called functional foods, for which consumers seem to show great interest [6].

As is known, functional foods are common foods which are naturally rich in physiologically active components or food that can be modified or innovated, in order to provide the consumer with additional benefits, in addition to nutritional ones [7]. On the other hand, the link between nutrition and health has been recognized since ancient times. This link is increasingly at the center of the attention of the modern consumer, for whom the diet must not only meet the body’s nutritional needs but also constitute a tool for the prevention and treatment of diseases and pathologies. From this point of view, functional foods are an important tool available to consumers, together with an adequate lifestyle, to achieve their health goals [8]. From the literature, it is known that various foods, especially of plant origin, represent a source of antioxidant compounds and/or other bioactive ingredients. Therefore, some studies are focused on the characterization of bioactive compounds present in different plant matrices and their possible role in various fields.

Below, the papers published in this Special Issue are briefly reported that deal with various aspects of bioactive compounds, such as their presence in various matrices, characterization, extraction processes, but also their technological applications.

In the work by Ilieva et al., the best winemaking procedure and the most efficient yeast strains for the production of high-quality wines from the Vranec and Cabernet Sauvignon vines were evaluated. For experimentation, two autochthonous strains of Saccharomyces cerevisiae were compared with a commercial yeast strain and the dynamics of alcoholic fermentation and the quality of the wines produced were evaluated. The results obtained confirm that the use of mixed starter cultures, as in this case, autochthonous and commercial yeast strains represent a promising approach to be explored using food engineering procedures [9].

Kołota and Głąbska evaluated the effects of a three-month daily intake of milk thistle seeds (Silybum marianum) on the biochemical parameters of patients with non-alcoholic fatty liver disease (NAFLD), a liver disease associated with obesity and the most common cause of chronic hepatitis. Previous research shows that milk thistle seeds are rich in antioxidant
compounds, such as silymarin, a mix of three active ingredients. Patients recruited for the study were evaluated for their diet, body composition and biochemical parameters. The results show the beneficial effects of taking milk thistle seeds in the daily diet [10].

Different plant extracts, in addition to having high antioxidant activity, show the ability to inhibit the growth of various tumor cell lines. In a work by Chaffari et al., the effects of essential oils and hexanoic, methanolic and aqueous extracts obtained from various parts (bark, needles and pollen) of Pinus eldarica plant against human lung cancer cells were investigated (A549). The experimental part was based on the characterization of the extracts, on the effects of exposure of A549 cells to various concentrations of the extracts and essential oils and on the analysis of the cell cycle. The results indicate the potential of P. eldarica for the development of new cancer therapies [11].

Some phytocompounds show significant effects in countering obesity. In a study by Oh et coll., the anti-adipogenic effects of looliolide, a monoterpenoid hydroxylactone present in many food plants, were evaluated using mesenchymal stromal cells derived from human bone marrow. In addition, its mechanism of action was investigated. The results support its possible use as an anti-adipogen agent for the treatment or prevention of obesity [12].

In a work by Tran et al., the antitumor and antioxidant potential and antimicrobial activity of various extracts of Euphorbia hirta L., a plant belonging to the Euphorbiaceae family, were evaluated. The results show that the extracts of this plant possess significant biological activities, including moderate antimicrobial, antioxidant and anticancer properties. Therefore, they could be a good source of natural antioxidants and a possible pharmaceutical supplement [13].

On the other hand, the antioxidant compounds contained in plant matrices can also have a pro-oxidant effect. Kołota et al. studied the pro-oxidative effect of the polyphenols contained in red wine on the liver of the growing organism. As is known, the polyphenols contained in red wine are responsible for its sensory characteristics, as well as numerous beneficial effects. In particular, this study aims to evaluate the association between the consumption of red wine and the intake of polyphenols in the diet with wine and the oxidative stress parameters in the liver of growing male rats. Although further studies are needed, the data obtained show the pro-oxidative effect of both ethanol and polyphenols on the liver of rats for a period of two weeks, while for longer periods there appears to be an adaptive mechanism of the organism in growth [14].

As previously reported, bioactive compounds are present in different matrices. An example is represented by Ganoderma lucidum, a fungal species much studied for the presence of numerous physiologically active components, such as triterpenes, peptidoglycans and polysaccharides. In a work by Salvatore et al., the aqueous extracts of G. lucidum spores obtained by two different extraction processes were studied, such as hot water extraction (HWE) and dynamic solid–liquid rapid extraction (RSLDE) using the Naviglio extractor. The obtained extracts were dialyzed and tested on two human carcinoma cell lines. The results show that the outside dialysis phase of the RSLDE extract is particularly cytotoxic for one of the two cell lines, suggesting its possible use as a chemopreventive and/or therapeutic agent [15].

In another study by Salvatore et al., three extraction processes were used, such as extraction with n-hexane, Soxhlet apparatus with n-hexane and reflux with chloroform, to evaluate the lipid content of the spores of Ganoderma lucidum. The obtained extracts were compared with a commercial sample of liquid G. lucidum spore extract obtained by supercritical CO2 extraction. The identification and quantification of the triglycerides of fatty acids contained in the spores were obtained by gas chromatography-mass spectrometry (GC-MS). The results show the validity and extraction efficiency of simple and low-cost methods compared to the more sophisticated and expensive ones [16].

In the context of compounds with beneficial effects on health, prebiotics are non-digestible substances of food origin useful for the growth and development of the intestinal microbiota, the mass of bacteria that lives in the digestive system of the human body
with important safeguard functions from harmful bacteria. Over the years, a lot of information has been gathered on these compounds; however, there is no accessible and convenient information space to compare the results obtained. Starting from these premises, Guseva et al. present in their paper a database called the ‘On-line Database of Researches on Activity of Prebiotics’ (ODRAP), which contains information on both prebiotics and some probiotics. Access to the database is achieved through a special web interface, which allows one to open the web page to obtain information on the characteristics and activities of prebiotics, sort the data by species and genus of bacteria, chemical nature or source of prebiotics and other parameters [17].

The bioactive compounds contained in some plant matrices, among the various biological activities, can be used as natural dyes and antioxidants. For example, the extraction of compounds from a root vegetable, such as red beetroot is of great interest to the meat industry, in order to limit the number and quantity of synthetic additives and increase the shelf life of the various products. In fact, beetroot contains dyes (betalains), antioxidants (betalains and phenolic compounds) and preservatives (nitrates). Therefore, in a review by Domínguez et al., the main biologically active compounds present in beetroot, the implications and health benefits of this precious vegetable are reported [18].

As repeatedly reiterated, plant matrices are a source of bioactive compounds, but while much research has been conducted on their derivation from fruits and flowers, to date, research conducted on European trees and shrubs has been scarce. Starting from these premises, Szwajkowska-Michalek et al. conducted research to systematize the results of literature studies on the knowledge of phenolic compounds present in trees and shrubs native to Central Europe. In this way, it was possible to provide information on this topic and highlight current knowledge gaps [19].

As is known, to obtain the bioactive compounds it is necessary to apply a solid–liquid extraction technique to isolate the extractable material containing the phytocompounds present in the most varied plant-type matrices. An example is the medicinal plant sector, from which active ingredients with pharmacological properties are obtained for the treatment of certain human pathologies and diseases. For example, chrysoeriol, a flavone synthesized in several plant species, is a phytocompound with numerous effects. Indeed, some investigations showed that this molecule has a broad range of biological potentials, including anticancer, anti-inflammatory, antidiabetic, antihyperlipidemic, antibacterial, antifungal, anti-osteoporosis, anti-insecticidal, antioxidant, and neuroprotective activities. In a paper by Aboulaghras et al., the in vitro and in vivo pharmacological properties of chrysoeriol are highlighted and information on its pharmacokinetics is provided [20]. Related fields for the use of phytocompounds are that of herbal medicine, cosmetics and perfumery which obtain the main ingredients of their preparations by subjecting parts of plants, such as flowers, leaves, roots, etc. to solid–liquid extraction [21,22]. For a while now, even in the food sector, greater attention has been paid to production processes with a constant search for new technologies with the aim of improving production efficiency, guaranteeing greater safety and quality, allowing the reduction of energy costs for the production of food with beneficial effects on health [23]. Similarly, in other industrial sectors, such as that of the beverage industry, a solid–liquid extraction is used to obtain alcoholic extracts of fruit peels, flowers, leaves, etc., which are then mixed with water and sugar to obtain the final product [24]. The list could still go on, recalling multiple industrial applications. On the other hand, the purpose of solid–liquid extraction is to obtain substances of interest from a medicinal or aromatic plant or other matrix that contains them by means of an appropriate solvent liquid. This operation allows to separate from the solid matrix the desired functional substances called drug or phytocomplex (set of chemical components with a specific pharmacological action). Preparations with a liquid consistency (liquid extracts and tinctures), semi-solid (soft extracts and oleoresins) or solid consistency (dry extracts) are defined as extracts. The extraction techniques are divided into conventional and innovative [25]. The former can be defined as more traditional methods with all the disadvantages of the less modern methods, namely the need for high amounts of solvent, low extraction
selectivity, the need for long times and thermal decomposition for thermolabile compounds. Instead, the innovative techniques, introduced relatively recently in the industrial field, have numerous advantages such as the reduction or elimination of the solvent, the reduction of energy consumption, the satisfaction of the legal requirements on emissions, the greater safety and control of the extraction technique, cost reduction and improvement of the quality and functionality of the entire process. In general, the most commonly used conventional and innovative techniques for extraction from the various solid matrices are: maceration (digestion, infusion and decoction); squeezing; percolation; steam distillation; extraction using the soxhlet device; rapid solid–liquid dynamic extraction (RSLDE) using Naviglio extractor; extraction with supercritical fluids (SFE); ultrasound-assisted extraction (UAE) [26,27]. The choice of methods and technologies related to an extraction process must take into account the peculiarities of the matrix, characterized by a certain structural complexity, based on the part of the plant that constitutes the phytocomplex and the nature of the compounds to be extracted. Therefore, it is necessary to consider their behavior in the presence of different solvent systems, the thermolability, the behavior according to the pH, the speed of passage in the solvent, and so on. In general, the extraction is carried out considering that, depending on the solvent and the chosen technique, certain compounds with similar chemical-physical characteristics will be extracted. The extraction with a certain solvent, in fact, concerns the entire range of components with characteristics of affinity towards it. In the case of extractions aimed at the isolation of a certain compound, known or not, its characterization will then be carried out by chemical analysis, separation systems by chromatographic analysis and structural determination by spectroscopic analysis.

Recently, research lines have been developed relating to the extraction and characterization of bioactive compounds from various matrices for the enhancement and recycling of waste material, in particular those coming from the agri-food sector [28]. In fact, to protect the environment and help reduce waste to a minimum, a circular economy model has currently been proposed. The latter is an ecosystem in which the recycling and regeneration of products and materials make it possible to reduce the use of raw materials and energy at source, creating a virtuous circle that protects the environment and reduces waste and production costs for companies. Therefore, the attention of research is increasingly focused on the reduction of chemical residues and on obtaining healthier products, encouraging the reduction of production waste and their reuse, enhancing the same with the use of innovative technologies, to reduce the minimum production of landfill waste. So far, however, the most frequent exploitation has been for agricultural production waste, but much less for agro-industrial ones which are still not very eco-sustainable and which require the use of very sophisticated techniques, such as extraction with supercritical fluids, or ultrasounds or microwaves, to obtain new products that can generate value. Therefore, with a view to sustainability, it is necessary to increase attention on the residues of the agri-food process, which are potentially very interesting for obtaining active extracts for defense in agriculture, molecules for the nutraceutical industry and to increase the shelf life of food, refining and overcoming the critical issues still existing on the methods and processes of recovery of these by-products.

Furthermore, to date, the studies that allow to highlight the role of bioactive compounds on health are not yet conclusive and are generally focused on specific compounds and their effects on a limited number of markers. In addition, many aspects related to their bioavailability, metabolism and excretion, interaction with the food matrix and with nutrients and other components of nutritional interest still remain to be clarified [29,30]. The bioavailability of phytochemicals can be influenced by factors intrinsic to food and the human body; these compounds are generally poorly absorbed, extensively metabolized and rapidly eliminated. For this reason, it is advisable that their intake is constant over time so that the plasma concentrations of the related metabolites remain high. In addition, it is important to create a barrier between sensitive compounds and the environment around them capable of stabilizing the different types of food ingredients and increasing their bioavailability. Recent technologies developed to prevent the deterioration of physi-
ologicaly active compounds include microencapsulation, edible films and coatings and vacuum impregnation [31,32]. Future studies will be able to provide further evidence on the functions of phytochemical compounds and on the mechanisms of action in physiological and/or pathological conditions and thus allow to suggest the reference levels of intake for the different population groups.

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