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Editorial

Special Issue: "Bioactive Compounds from Various Sources: Beneficial Effects and Technological Applications II"

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Bioactive components are substances that positively influence the organism, resulting in a physiological benefit and/or reduction in the risk of developing certain pathologies. They are generally found in small quantities in food matrices, especially of vegetal origin (phytocompounds). Unlike essential macro- and micronutrients, such as fats, carbohydrates, proteins, vitamins and minerals, they are not essential for life, but they have beneficial effects on health due to their antioxidant and anti-inflammatory actions. On the other hand, these compounds are bioactive precisely because they can modulate some important biological functions. Resultantly, scientific consensus recognizes their numerous potentialities, although many aspects related to their bioavailability, metabolism and compartmentalization, excretion and interactions with food matrices, nutrients and other components of nutritional interest still need to be clarified. Furthermore, the low solubility, poor stability and low bioavailability of these compounds significantly limit their applications in the food and medical fields. Consequently, to overcome these limitations, uses of nanotechnologies have recently been introduced that protect bioactive compounds. In addition, their encapsulation in nanoparticles can control their release under specific conditions. Therefore, nanotechnologies provide an ideal delivery system to improve the pharmacokinetics and bioavailability of bioactive compounds to obtain functional foods.

All of these aspects favor the development of numerous lines of research involving bioactive compounds, ranging from their extraction to use in various sectors, such as the pharmaceutical, cosmetic and food sectors. Therefore, many experimental approaches involve the extraction of such compounds via various procedures and sources, including waste material, especially that coming from the agri-food sector. In fact, part of this waste is used in animal feed, fertilizer production, compost and biogas, but this resource can also be valorized by re-introducing it into the production cycle and extracting these precious substances, thus increasing the sustainability of production, reducing disposal costs and limiting the environmental impact based on the current principle of the circular economy.

In this Special Issue, 27 innovative research studies have been collected concerning bioactive compounds and their technological applications.

Bušová et al.'s study focused on comparing the long-term effects of different concentrations of humic additives in aquaculture on growth and production parameters, antioxidant status, stress resistance, gut microbiome, the sensory properties of fresh and cooked meat, fatty acid content and atherogenic indices and thrombogenic elements of African catfish (*Clarias gariepino*). African catfish constitutes a suitable and readily available source of unsaturated fatty acids, which are very important in human nutrition as they prevent cardiovascular diseases. The reported data offer information on the health, meat quality and fatty acid composition of commercial-sized *C. gariepinus* [1].

Recently, the use of biologically active substances derived from foods as ingredients of drugs, dietary supplements and new options for chemotherapy has increased. In this context, in Synowiec-Wojtarowicz et al.'s study, the impact of the simultaneous exposure of malignant melanoma cells to resveratrol and the static energy of magnetic fields generated using permanent magnets in cellular redox homeostasis was analyzed. The results show

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Citation: Gallo, M. Special Issue: "Bioactive Compounds from Various Sources: Beneficial Effects and Technological Applications II". *Appl. Sci.* **2023**, *13*, 10816. https://doi.org/10.3390/app131910816

Received: 27 September 2023
Accepted: 28 September 2023
Published: 29 September 2023

that this effect depends on the chemical structure of the antioxidant substances used, as some of them, working in combination with the field, show a strong anti-tumor effect, while others, such as resveratrol, lose their anti-tumor properties under the influence of a moderate-intensity static magnetic field [2].

Current data show that the incidence of superficial infections, including oral candidiasis, has recently significantly increased. Therefore, in their study, Biernasiuk and Malm evaluated the antifungal activity of the natural terpene linalool against *Candida* spp. isolated from the oral cavities of immunocompromised hemato-oncology patients. Their results confirmed the in vitro sensitivity of yeast reference strains belonging to selected species of *Candida* spp., *Cryptococcus* spp., *Geotrichum* spp. and *Saccharomyces* spp. to linalool. Furthermore, synergistic interactions between linalool and some antiseptics improved their antifungal efficacy and provided a basis for the development of new antifungal formulations [3].

Metal-based drugs have gained ground in cancer therapies, as they have fewer side effects and resistance. Bortolamiol et al.'s review summarizes the main progress achieved in the last three years in the use of bioconjugated metal complexes for cancer therapy. These results, together with those obtained in recent decades, show that the introduction of biologically relevant portions into the coordination sphere of transition metal centers could improve the selectivity and biocompatibility of metallodrugs [4].

Laranjeira et al.'s study evaluated the effects of extracts of the aromatic plant *Pterospartum tridendatum*, an important source of active compounds, in treating acute and chronic inflammation in adult rats using an experimental model of osteoarthritis and ear edema and correlated it with its phytochemical composition. Furthermore, the molecular interactions between the main phytochemical compounds of *P. tridentatum* and the proteins involved in the inflammatory response were evaluated to clarify the possible mechanism of action. The results highlight the potential of *P. tridentatum* extracts as a source of compounds used as adjuvants in the management of pain and inflammation [5].

Beitane and Marisheva based their research on consumers' increased interest in the vegan diet and the contemporary need for new nutritious products that can overcome the nutritional deficiencies of this diet. Therefore, the potential of amaranth pasta and amaranth pasta mixtures with buckwheat or oat flour in to provide essential nutrients in a vegan diet was evaluated in the study. The results show that to ensure healthy eating and meet the needs of a vegan diet, a nutritious pasta can be obtained by replacing amaranth flour with buckwheat or oat flour [6].

An increasing number of infections are becoming more difficult to treat with current antibiotics, increasing health risks. In this context, Kakouri et al. studied nine species of *Hypericum* for their antimicrobial activity and their total phenolic and flavonoid content. The extracts were tested against Gram-negative and -positive bacteria. The results obtained indicated that *Hypericum* species were good sources of secondary metabolites. Notably, Gram-negative bacteria were resistant to the tested extracts, while Gram-positive bacteria were successfully inhibited [7].

Astragalus membraneceus is a herbaceous plant belonging to the legume family, the immunomodulatory effects of which are well known, unlike its antimutagenic activity, which is little known. The plant's root was used. In Park et al.'s study, the antimutagenic and immunomodulatory effects of astragalus root were evaluated using a cyclophosphamide-induced immunosuppressed mouse model to develop an alternative immunomodulatory agent. The results obtained show that astragalus root, at an appropriate oral dose, could act as an alternative agent with significant antimutagenic and immunomodulatory properties [8].

Oxidative stress is a pathological condition caused by the breakdown of the physiological balance, in a living organism, between the production and elimination of oxidizing chemical species by antioxidant defense systems. This condition is associated with numerous human pathologies. Minh et al.'s study investigated whether a herbal blend consisting of *Cleistocalyx operculatus* teas could improve health. A mixture of *C. operculatus* and *Mentha*

arvensis, at a ratio of 7/3, led to the best results in terms of taste (sensory tests). Furthermore, the potential health benefits against oxidative stress remained high compared to pure *C. operculatus* infusion [9].

The high global consumption of coffee creates problems related to disposing of or processing by-products. However, valuable chemical compounds can be extracted from spent coffee grounds and used in the food industry. Chatzimitakos et al. investigated the parameters influencing the extraction of caffeine and polyphenols, such as chlorogenic acid, neochlorogenic acid and caffeic acid, and evaluated the antioxidant properties of such extracts. The results obtained showed that a low extraction temperature (20 °C) allowed the extraction of bioactive compounds from spent coffee grounds, reducing the environmental impact and the costs of the extraction process [10].

The production of bioactive compounds from microalgae biomass using efficient and environmentally friendly technologies is of great interest to researchers. In Georgiopoulou et al.'s study, the interest was focused on the recovery of bioactive components with high added value from the microalgae *Chlorella vulgaris*. For this purpose, conventional solid–liquid extraction was compared to microwave-assisted extraction (MAE) and supercritical fluid extraction (SFE). The results revealed that conventional extraction had the highest yield. However, MAE and SFE methods derived competitive or better quality extracts with a significantly shorter extraction time [11].

Aging is a natural phenomenon, which is accompanied by a progressive decline in various functions of an organism. The changes that occur can, at least in part, be alleviated via exercise, an adequate diet and some natural adjuvants. In Dobroslavić et al.'s review, the potential of bay leaf polyphenols (*Laurus nobilis* L.) to modulate body composition was evaluated. The review shows that the main polyphenols of bay leaves have various positive effects on bones, skeletal muscle and adipose tissue. Therefore, they could promote healthier aging [12].

Allelopathy plays a very important role in the defense of plants, which emit substances called allelopathics that inhibit the growth of nearby plants, gaining an ecological advantage. In Erhatić et al.'s study, the possible allelopathic influence of aqueous extracts derived from the plant species chia (*Salvia hispanica* L.), black cumin (*Nigella sativa* L.), wormwood (*Artemisia absinthium* L.) and nettle (*Urtica dioica* L.) was investigated based on the germinative growth of seeds and the morphometric characteristics of pepper (*Capsicum annuum* L.), spinach (*Spinacia oleracea* L.) and lettuce (*Lactuca sativa* L.) seedlings kept under laboratory conditions. The results obtained show that at various treatment concentrations, spinach seeds with aqueous chia extract (2.5%) before germination stimulate the germination of spinach seeds, while wormwood herbs and chia extracts (2.5 and 5%) stimulate the germination of lettuce seeds and growth of the hypocotyl and radicle lengths of the developed seedlings. The treatment of pepper and lettuce seeds with aqueous nettle extract (10%) completely inhibited seed germination [13].

Based on the circular economy principle, Loulidi et al. transformed spent coffee grounds into powdered activated carbon via chemical activation using potassium hydroxide. Its characterization was conducted in comparison to that of a commercial activated carbon using scanning electron microscopy (SEM) coupled with energy dispersive X-ray microanalysis (EDX), X-ray diffraction (XRD), transform infrared spectroscopy Fourier (FTIR) Boehm titration and point of zero charge (pHPZC), as well as via the determination of methylene blue number (MBN) and iodine number (IN). The results obtained show that the produced activated carbon can be used as an alternative adsorbent to remove cationic dyes and heavy metals from aqueous solutions [14].

Hemp (*Cannabis sativa* L.) is a precious source of many bioactive substances. The purpose of Kobus et al.'s study was to optimize the effects of particle size, time and ultrasound intensity during the extraction of phenolic compounds from hemp. The results obtained show that after reaching the optimum level for unit energy inputs, a further increase in extraction efficiency translates into a very rapid increase in energy consumption [15].

Melanoma is a very aggressive tumor resulting from the malignant transformation of melanocytes, the cells that determine the color of the skin. In the literature, it is reported that *Rosa rugosa* has antioxidant, antibacterial, anti-tumor and anti-inflammatory activities. In Zhou et al.'s study, the melanogenesis-suppressing effect of *R. rugosa* extract and its solvent fractions on melanogenesis-related gene and protein expression was evaluated. The results obtained show that *R. rugosa* effectively suppressed melanin secretion and tyrosinase activity at non-cytotoxic concentrations [16].

Fucoidan is a polysaccharide present in the cell walls of many brown algae species, capable of improving the function of the immune system and providing antioxidant protection. In Lakshmanan et al.'s study, fucoidan was extracted from marine macroalgae *Sargassum ilicifolium*, and its bioactive potential for use in in silico molecular docking was studied. In vitro tests revealed that fucoidan possessed diverse antioxidant properties and anticoagulant activities, thus providing a basis for broadening its application as a pharmaceutical ingredient [17].

Pericoronitis is an acute inflammatory condition that affects the gum surrounding the erupting tooth. In Coșarcă et al.'s clinical study, the effect of beech bark extract (BBE) on the treatment of pericoronitis of the lower third molar was evaluated. The parameters evaluated were pain, trismus and bleeding index. The results showed that BBE-based irrigation more effectively reduced pain, trismus and bleeding compared to the alternative solutions [18].

The predisposing factors influencing the development of tumors also include viral and/or bacterial infections, as well as chronic inflammation. The *Ptaeroxylon obliquum* plant is traditionally used to treat various infections characterized by inflammation. Khunoana et al. determined the in vitro antiproliferative and antioxidant activity of *P. obliquum* leaf extracts, fractions and isolated compounds. Their results show that *P. obliquum* extracts have selective cytotoxicity against tumor cell lines and could, therefore, support anti-tumor therapy [19].

In Nayak et al. study's, nonlinear signal decomposition methods were used to process heart rate variability (HRV) signals to detect possible alterations in cardiac autonomic regulation (CAR) due to cannabis use. Empirical mode decomposition (EMD), discrete wavelet transform (DWT) and wavelet packet decomposition (WPD) methods were used to identify variations in CAR activity in a population that habitually consumes bhang (a cannabis-based product). Furthermore, a machine learning (ML)-based model was designed for the automatic detection of cannabis users. The results allowed the authors to highlight a specific model as being most suitable for automatically identifying cannabis users [20].

Dendritic cells play a major role in the immune response, as they are responsible for capturing antigens and presenting them to lymphocytes to allow a specific immune response to be activated. Various studies have reported that malignancies or cancers can impair dendritic cell and effector T cell functions. Therefore, some research focused on using dendritic cells as a new molecular target for cancer treatment. Ahmed et al. evaluated the effects of various plant matrices and their phytochemical compounds in terms of modulating the immune system and signaling pathways involved in anti-tumor immunity. Although further studies are necessary, the data obtained were sufficiently encouraging to allow the authors to create pharmacological modulators of plant origin for dendritic cell-based anti-tumor immunotherapy [21].

Diabetes mellitus is a chronic disease characterized by an increase in the concentration of glucose in the blood. In Handayani et al.'s study, ethanol extracts derived from soursop leaves (*Annona muricata*, an evergreen tree), known for its antidiabetic potential, were characterized. In particular, the effect of the extract on the renal histopathology of Swiss Webster mice with alloxan-induced diabetes was evaluated. The results obtained indicate the therapeutic potential of *A. muricata* in performing kidney restoration in diabetes mellitus patients [22].

Atopic dermatitis (AD), also known as atopic eczema, is a condition causing chronic, non-contagious inflammation of the skin. Lee et al. studied the inhibitory effects of *Cornus walteri*, a deciduous shrub already used in traditional medicine, on AD. In particular, the anti-inflammatory activity of the MeOH extract of *C. walteri* stems (CWS) was evaluated using the human keratinocyte cell line HaCaT. Characterizing the compounds isolated from CWS allowed the authors to hypothesize their future use as therapeutic agents for the treatment of AD [23].

Vitamin D is essential for calcium and phosphate homeostasis; therefore, it is crucial for the growth and maintenance of the skeleton. In Kasarla et al.'s study, the impact of chrysin, a proven inhibitor of the CYP3A4 enzyme, which promotes the inactivation of active vitamin D, as an intervention, as well as its effects when used in combination with low-dose vitamin D3 (40 IU) to maintain bone health in conditions of vitamin D deficiency, was evaluated. The results obtained indicate that although chrysin alone had a notable effect on 25-hydroxyvitamin D3 and bone tissue, it had an intensified therapeutic effect when used in combination with vitamin D3 and CaCO3 to improve bone health [24].

In aquaculture, feed must provide favorable growth rates, animal health and feed efficiency to obtain a viable product for the consumer. Therefore, more environmentally and economically sustainable ingredients, such as plant bioactive compounds, are increasingly used in feed formulations. In Penglase et al.'s study, the effects of dietary additions to a polyphenol-rich sugarcane extract (PRSE) on the survival, feed conversion ratio and pathogen load of black tiger shrimp (*Penaeus monodon*) was studied. The results obtained showed the potential of these formulations to improve the growth of shrimp [25].

Daucosterol, a glucoside of β-sitosterol, is a natural compound similar to phytosterol. Several studies report its potential pharmacological properties, such as antioxidant, antidiabetic, lipid-lowering, anti-inflammatory, immunomodulatory, neuroprotective and anticancer activity. In El Omari et al.'s review, data were reported through the analysis of the phytochemical, biological and pharmacological processes of the daucosterol molecule. Furthermore, the authors explain the mechanism of action (in vitro and in vivo) and the future applications of this secondary metabolite in the pharmaceutical field, in particular in terms of its neuroprotective and chemopreventive effects [26].

A food is defined as functional if, in addition to its nutritional properties, it has a scientifically demonstrated ability to positively influence one or more physiological functions, improving human health and reducing the risk of developing diet-related diseases. Several foods, including tubers, can be sources of antioxidants and other bioactive ingredients. In Arshad et al.'s study, the approximate composition, minerals, pulp color, phenolic composition and antioxidant activities of white-fleshed sweet potato (WFSP) and potato (WFP) varieties grown in Pakistan were compared. The results show that WFSP has a better proximal and mineral profile, followed by enhanced antioxidant activity [27].

To conclude, in this Editorial, 27 papers on different approaches regarding the use of bioactive compounds have been collected and summarized. However, due to the importance of these compounds and their application in various fields, studies in this area are still ongoing, as many aspects still need to be further investigated. Therefore, this field of research will continue to advance.

Funding: This research received no external funding.

Acknowledgments: I would like to thank all of the authors and peer reviewers for their valuable contributions to this Special Issue, titled "Bioactive Compounds from Various Sources: Beneficial Effects and Technological Applications II". I would also like to express my gratitude to all of the staff and contributors involved in this Special Issue. Finally, I would like to thank Maddie Ke for all the support that she provided.

Conflicts of Interest: The author declares no conflict of interest.

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