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Editorial

Plants, Lichens, Fungi and Algae Ingredients for Nutrition and Health

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There is a high awareness in the industry of the need to develop food products enriched with health-promoting ingredients and to avoid nutrition-related disorders. An increasing amount of research has been conducted aiming to further understanding of these issues, as well as research focusing on the opportunity to use various plants, lichens, and algae products and by-products in the food industry and in animal feed. These studies deal with the valorization of unconventional sources of bioactive compounds, aiming to increase the nutritional value of staple food or to improve meat quality in a sustainable way.

The use of ingredients rich in proteins and high-quality fatty acids in bird feed impacts the bird's welfare, egg quality, and overall production performance. The exploration of alternative sources for poultry nutrition may lead to difficulties regarding food security. In this context, microalgae represent a feasible and eco-friendly solution in animal and poultry diet formulation due to their high protein content and high levels of omega-3 fatty acids. Microalgae are also rich in polysaccharides, vitamins, pigments, enzymes, etc., while the biologically active compounds present in microalgae are involved in disease prevention and helping the immune system due to their antioxidant, antimicrobial, and immunomodulatory properties. Additionally, microalgae are regarded as eco-friendly because they have a low influence on land and water resources. Another plant ingredient that is used as a protein supplement due to its high-quality protein is soybean meal. Soybean meal is recognized as a balanced amino acid source with a very high protein digestibility, which is essential for the overall growth of birds and egg production. An alternative, used to supersede part of the soybean meal included in poultry diets, is represented by Chlorella (*Chlorella vulgaris*), a naturally single-celled green microalga. This food source, appreciated due to its particular and variate composition of beneficial macro- and micro-nutrients, includes proteins, omega-3 polyunsaturated fatty acids, polysaccharides, vitamins, and minerals. Panaite et al. [1] illustrate the possible influences of chlorella and spirulina, which can partially substitute soybean meal at equivalent inclusion levels in the diet of laying hens, on poultry productivity and egg quality. A significant improvement in egg quality and nutritional profile in terms of egg weight and size, intensity of yolk color, beta carotene content, and antioxidant capacity was observed when chlorella and spirulina at a concentration of 2% each were used to supplement laying hens' diet. Moreover, the addition of chlorella led to a remarkable rise in omega-3 polyunsaturated fatty acids, with crucial implications beyond poultry production.

Wheat, one of the best-known cereal crops in the world, represents the main food source of most communities. The varieties of wheat present different grain characteristics related to their genetic diversity, with an impact on the milling and bakery sectors. Romania is recognized as one of the most important producers of wheat in Europe and the world.

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Golea et al. [2] investigated the genetic varieties by employing Inter-Simple Sequence Repeats (ISSR) markers of 31 wheat samples cultivated in Romania, from various sources, and maintained in the active collection of the "Mihai Cristea" Suceava Plant Genetic Resources Bank. The physical, chemical, and genetic diversity properties of the various wheat varieties grown in Romania exhibited significant variations between ancient and modern wheat species in terms of ash, protein, wet gluten, lipid, and starch contents, as well as their falling number and damaged starch values. The ISSR-type molecular markers are useful and relevant to genetic diversity research. The findings of this study suggest that knowledge of the genetic diversity of germplasm collection and investigations into the magnitude and nature of genetic variations in wheat are crucial for breeding programs and the preservation of genetic resources. Additionally, when taking into account the wheat samples that were investigated, the ancient ones presented the best quality for bread-making, as they have the greatest quantity of fat and minerals.

White wheat flour is usually the basic ingredient in bread, but it has a lower nutritional quality due to the considerable loss of dietary fiber, vitamins, minerals, and phytochemicals during the refining process. Researchers are concerned with the development new functional food and creation of sustainable food systems, taking into account the alternative uses of vegetable by-products. Many studies have focused on enhancing wheat bread with valuable food industry waste products with high levels of phenolic antioxidants. The impact of the incorporation of fresh or freeze-dried pistachio hulls and grape seeds on the total phenolic content, antioxidant activity, moisture content, crust and crumb color, specific volume, baking loss, and textural and sensory profiles of white wheat bread was specifically investigated by the Koç and Atar Kayabaşi [3]. The obtained results show that the majority of bread properties are influenced by the amount of the ingredient used; thus, it is crucial to control the quantity of these by-products in bread. The results reveal that pistachio hull powder is rich in antioxidants, polyphenols, and fibers, and thus can be considered a valuable functional ingredient in breadmaking. An advantage of the use of pistachio hull powder in bread is that it led to a significant increase in phenolic content and antioxidant activity; however, the sensory profile of the final product was affected and lower scores were obtained compared to the control.

Various types of breakfast baked goods, mostly manufactured from flour, sugar, fats, and eggs, present a lipid content of up to 24–40% relative to the flour content, whether of animal or vegetable origin. Researchers face a notable challenge in their attempts find a feasible solution to reducing the lipid content in bakery products, since it is known that fat influences the sensory and texture profile of the final product. Many studies are centered on diminishing the amount of lipids in muffin cakes by replacing them with various lipids mimetics, such as starch, chia seed mucilage, inulin, cocoa fibers, gums, polydextrose, and legume/fruit purees. One alternative to fat in muffins is represented by oleogels, which also benefit human health compared to shortenings and saturated fats. In this context, Banu et al. [4] studied the influence of soy-, lupin-, and yeast protein-based emulsions as oil substituents on the rheological properties of muffin batter and the characteristics of the final product. The results revealed different contributions of the emulsions to the rheological properties of dough, depending on the ingredients that were used. Changes in starch gelatinization and Mixolab torque values were observed when sunflower oil was replaced with various emulsions. The final products exhibited higher moisture, increased firmness, good CO_2 retention, and acceptable sensory characteristics compared to the control. This research confirmed the suitability of replacing fat with some protein emulsions in muffins.

Some researchers focused on the development of innovative packaging or bioactive packaging that liberates the compounds. A novel approach to the manufacturing of bioactive films is the addition of various types of fruit juices into the film-forming solution (FFS) to obtain an intake of antioxidants. As considered by Avramia and Amariei [5], yeast cell walls or the β-glucans extracted by purification from the cell walls can be the proper matrices of FFS, with immunostimulatory benefits. A study was conducted to analyze the bioactive films manufactured from β-glucan and the three kinds of fruit juices regarding the

uniformity of film thickness, moisture vapor transmission rate, water vapor permeability, and dissolution time. As stated by these authors, the quantity of the juice and gelling agents plays an essential role in changing the physicochemical characteristics of the bioactive films.

At present, non-traditional flours made of different raw products are attracting the attention of researchers and the food industry. Plant-based products are becoming increasingly popular on the market and there is a growing diversity of flours that can be used in food preparation. The differences between these flours consist mainly in their ingredients, origin, and processing process. These flours can be used to improve the rheological profile of doughs through their inclusion in wheat flour used for baked goods, to improve the texture characteristics of foods, and/or to enhance their nutritional profile. Vivar-Quintana et al. [6] evaluated the nutritional properties of ten commercial flours containing rice, pea, chickpea, soybean, and hemp concerning current nutritional guidelines and dietary requirements. Even if plant-based flours are included with a generic expression, their nutritional value differs according to their distinct composition. The flours considered in the research showed carbohydrates as a main component, and exhibited similar energy values. The results revealed that pea and chickpea are a great source of proteins and fibers, while soybean and hemp are rich in fat. The main macro- and microelements found in all flours are potassium, phosphorus, and iron.

Consumers are currently aware of the high-quality chicken meat usually obtained in organic systems and the valorization of organic food industry by-products. The literature highlights the possibility of using microbial pigment sources in poultry nutrition with many advantages related to the time needed, costs, and environmental protection. A good source of carotenoids, lipids, and enzymes is represented by yeast. In this regard, Grigore et al. [7] evaluated the singular and the interaction effects of the dietary yeasts' lyophilized lysate supplements when included in broilers' diet on the carcass yield and breast and thigh meat properties in terms of pH, color, nutritional profile, texture profile analysis, and sensorial characteristics. As observed in their work, the inactive yeasts *Saccharomyces cerevisiae* and *Rhodotorula mucilaginosa* influenced the physical and mechanical properties of meat. Bivalent yeast supplementation resulted in an enhancement of meat quality via an increase in moisture, lightness, and redness, and a reduction in the browning index. This sensory evaluation of meat confirmed the possibility of using yeast supplements as a feasible alternatives to feed additives.

Carrot (*Daucus carota* subsp. *Sativus*) is a popular vegetable used in the human diet that has many nutritional benefits. It is a valuable source of vitamin A (beta-carotene) and dietary fiber, but it also contains significant amounts of potassium and antioxidants like luteolin, which benefits the cardiovascular system. Chomanov et al. [8] evaluated the effect of carrots on the nutritional and biological value of canned goat meat. According to them, the replacement of a part of the goat meat with carrots had a considerable impact on the chemical, amino acid, vitamin, and mineral profile of canned food. A variation in the characteristics according to the amount of carrot added was observed, whereas the sensorial characteristics presented differences in color, taste, consistency, and odor. According to these authors, the inclusion of carrots can lead to an increase in the final product's biological value and an enhancement of the canned goat meat's palatability.

There is a growing interest in healthier food, promoting the reformulation of some products through reducing or replacing some components, like carbohydrates or lipids, or using natural additives while maintaining the sensory and safety of the product. Metri-Ojeda et al. [9] investigated mayonnaise made of egg yolk, *A. platensis* protein, and sodium alginate, motivated by Mexican consumers who consider proteins to be a natural ingredient with acceptable characteristics. According to the results obtained, the emulsion-filled gels are a good alternative for low-fat mayonnaise because they present acceptable stability, a rheological behavior close to that of commercial mayonnaise, and a rise in the bioavailability of essential amino acid content, after buccal and gastric digestion. Furthermore, there is the option of creating an acceptable product from vegetable protein with a small amount of oil. Considering the purchase intention results, the best mayonnaise formulations

would be made of soy protein isolate with 22.5–30% oil or *A. platensis* protein concentrate with 30% oil.

Usnea barbata (L.) Weber ex F.H. Wigg (*U. barbata*) is a medicinal belonging to the lichens category from the *Usnea* genus (*Parmeliaceae*, lichenized *Ascomycetes*), which is a great source of bioactive secondary metabolites. Popovici et al. [10] investigated the physico-chemical characteristics of two distinct parts of the thallus layers, namely the medulla–cortex and central cord, and the whole dried *U. barbata* thallus. The results revealed that the central cord fraction has the smallest mineral content, color intensity, lightness, and total polyphenols content, followed by the whole lichen and medulla cortex fraction. The greatest polyphenols content, correlated with the antioxidant activity, was observed in the medulla cortex fraction, with the results depending on the solvent used. The extraction of the bioactive metabolites from the medulla cortex fraction could increase the yield and selectivity.

The current trends regarding the addition of functional ingredients to monogastric animal feed were observed, aiming to enhance the performance and increase the sustainability under different raising conditions. The nutritional value and the potential benefits of Jerusalem artichoke (*Helianthus tuberosus* L.) made it a great candidate to improve monogastric diets. In this sense, Cornescu et al. [11] reviewed the existing literature regarding the opportunity to use Jerusalem artichoke in monogastric animal feed and its effects on the production performances, along with the potential prebiotic activity of this ingredient. Based on the existing data, the authors concluded that Jerusalem artichoke has prebiotic properties and contributes to the enhancement of the gastrointestinal microbiota and production parameters.

The papers published in this Special Issue confirm the actual trends regarding the use of plant ingredients to enhance the nutritional, physical, and sensory characteristics of various food products. Furthermore, the positive effects of plant ingredients, when used in animal feed, on the quality of meat are also noted.

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