Nutritional and Functional Properties of Oyster Mushroom (*Pleurotus ostreatus*) Based Protein Bar: A Review

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Abstract— *Oyster mushrooms (Pleurotus ostreatus) have emerged as a versatile and nutritionally valuable fungi with significant potential in the food industry. Native to temperate and subtropical regions, these mushrooms have been cultivated globally due to their ease of growth, high yield, and adaptability to diverse agricultural by-products as substrates. Their production involves environmentally sustainable practices, utilizing lignocellulosic waste materials such as straw, sawdust, and husks, thereby contributing to waste reduction and promoting circular agricultural systems. Pleurotus ostreatus is known for its remarkable nutritional profile, including high- quality proteins rich in essential amino acids, dietary fibers, vitamins, and bioactive compounds like β-glucans and polyphenols, which are associated with numerous health benefits such as immune system support, cholesterol regulation, and antioxidant effects. This review highlights the innovative application of oyster mushrooms in the formulation of protein bars, leveraging their functional properties such as binding, texture enhancement, and prolonged shelf stability. The incorporation of these mushrooms into protein bars not only enriches their nutritional value but also aligns with consumer demands for plant-based, nutrient-dense food products. Additionally, the potential of Pleurotus ostreatus in addressing sustainability challenges and catering to modern dietary preferences underscores its relevance in functional food development. By tapping into the nutritional and functional properties of Pleurotus ostreatus, this paper aims to contribute to the advancement of innovative and sustainable food products that align with contemporary health and environmental goals.*

Keywords— Oyster Mushroom, Nutritional Properties, Functional Food, Protein Bar.

I. INTRODUCTION

Mushrooms are regarded as functional foods, with health advantages that extend beyond the usual nutrients they contain[1]. However, until the last decade, knowledge of the composition and nutritional worth of culinary mushrooms was limited in comparison to vegetables and medicinal mushroom species. Because culinary mushrooms have always been regarded as a delicacy, their usage in many developed countries has been marginal, making them of little interest to researchers. However, the situation has begun to alter noticeably: the number of original papers published each year is now many times higher than it was 10-15 years ago[2]. Among the abundance of edible mushrooms, the Pleurotus genus is a prolific producer of unique "Mycochemicals"

Pleurotus was initially cultivated in Germany during World War I as a subsistence measure for food preservation, and was the first to document the crop. Today, various species of Pleurotus are cultivated commercially because of their rich mineral content and therapeutic characteristics, short life cycle, reproducibility in the recycling of certain agricultural and industrial wastes, and minimal demand for resources and technology[4]. There is a greater need than ever for food items that meet both sustainable standards and nutritional needs. The oyster mushroom (Pleurotus ostreatus), a diverse fungus with excellent nutritional

properties, is one item gaining traction in this space. These mushrooms are simple to grow and thrive on agricultural byproducts such as straw and sawdust, making them an effective tool for encouraging waste recycling and environmentally friendly farming practices.[5],[6] Pleurotus ostreatus is known for its high protein content, essential amino acids, dietary fibers, and bioactive substances such β-glucans and polyphenols.[7] These components not only add nutritional value but also provide a variety of health benefits, such as immunological boosting, cholesterol management, and antioxidant capabilities.[8] Furthermore, oyster mushrooms have functional features such as binding and texture enhancement, making them ideal for use in novel food formulations such as protein bars.[9] Protein bars have been a popular dietary choice among health- conscious consumers due to their convenience, nutrient density, and flexibility to accommodate certain dietary preferences, such as plant-based and environmentally friendly options.[10] However, the use of sustainable ingredients such as oyster mushrooms in protein bars is an underexplored field with enormous potential for innovation. Many studies from around the world have confirmed that the Pleurotus mushroom is highly nutritious and contains a variety of bioactive compounds such as terpenoids, steroids, phenols, alkaloids, lectins, and nucleotides, which have been isolated and identified from the fruit body, mycelium, and culture broth of mushrooms and have shown to have promising biological effects.[11]

II. TAXONOMIC CLASSIFICATION OYSTER MUSHROOM:

- Kingdom : Fungi
- Phylum : Basidiomycota
- Class : Agaricomycetes
- Order : Agaricales
- Family : Pleurotaceae
- Genus : Pleurotus
- Species : P. ostreatus

2.1 Cultivation of oyster mushroom:

Oyster mushrooms (Pleurotus spp.) are grown with simple techniques and sustainable practices that include agricultural byproducts like wheat straw, sawdust, and paddy husks. The process starts with base preparation, in which lignocellulosic materials are chopped, soaked, and pasteurized with hot water or steam to remove impurities. This is followed by spawning, in which fungal mycelium is implanted into sterilized grains under sterile conditions to produce spawn, which is then placed on the substrate in ventilated bags or trays that provide air circulation and moisture for mycelial growth.[12]

During incubation, the base material is kept in a controlled dark and humid environment at temperatures ranging from 20°C to 30°C to ensure effective mycelial colonization. After colonization is complete, the substrate is exposed to light and fresh air to start fruiting, which typically occurs within 15-20 days. Mushrooms are collected by carefully twisting them from the base material. Proper handling preserves the mushrooms' nutritional and functional characteristics, making them acceptable for ingestion or further processing. Oyster mushroom production promotes sustainable agriculture by converting agricultural waste into useful food resources.[13],[14]

2.2 Nutritional Profile of Oyster Mushroom:

Oyster mushrooms are well-known for their outstanding nutritional profile, making them an important functional food. Their balanced composition comprises macronutrients and micronutrients that are beneficial to general health.

2.2.1 Macronutrients:

- **Protein:** Oyster mushrooms are a good source of plant-based protein, with 17-42 g per 100 g of dried mushrooms. They are high in essential amino acids, making them an excellent vegetarian protein source.[15]
- **Carbohydrate:** These mushrooms contain 50-60% carbs, mostly in the form of polysaccharides, which provide dietary fiber and promote intestinal health. Pleurotus eryngii has the greatest carbohydrate content of any species, with around 41 g per 100 g.[16]
- **Fat:** Oyster mushrooms are low in fat and mostly contain linoleic acid. Comparative studies have revealed that lipid content varies by species, with Pleurotus sajor-caju having up to 0.61 g per 100 g.[16]

2.2.2 Micronutrients:

- **Vitamins:** These mushrooms are high in B-complex vitamins, including thiamine, niacin, and folic acid. However, they contain very little vitamin B12.
- **Minerals:** Oyster mushrooms contain vital minerals such as potassium, selenium, zinc, and iron. These minerals are essential for maintaining health, including immunological function and lowering oxidative stress.[17]

2.3 Bioactive Compounds:

Oyster mushrooms contain bioactive compounds such as β-glucans, polyphenols, and antioxidants. These chemicals have been related to a variety of health advantages, including cholesterol management, immune system strengthening, and anti-inflammatory activity.[18]

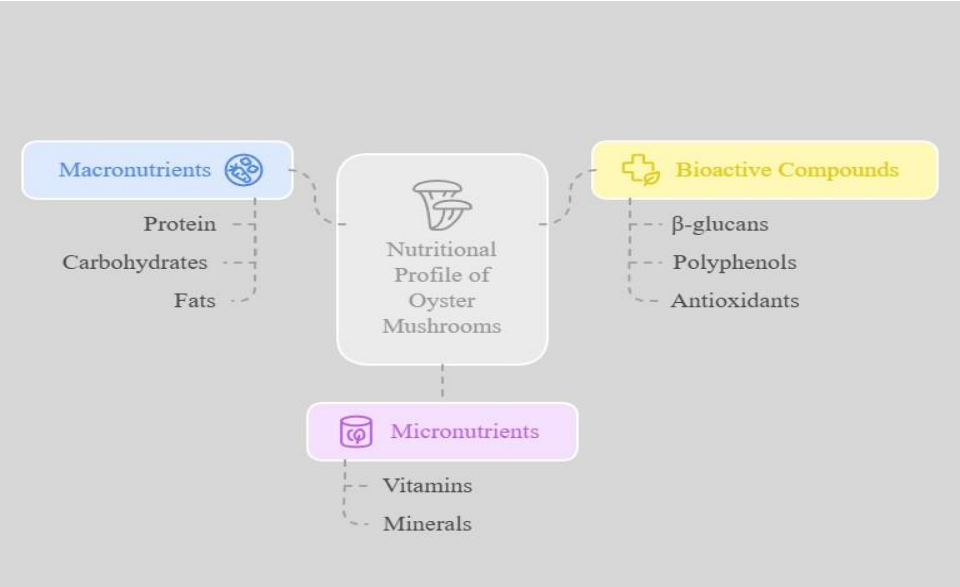

FIGURE 1: Nutritional Profile of Oyster Mushroom

2.4 Functional Profile of Oyster Mushroom:

Oyster mushrooms offer a diverse array of functional properties that contribute to their applications in health, nutrition, and food industries.

2.4.1 Antioxidant Properties:

Oyster mushrooms are rich in bioactive compounds such as ergothioneine, phenolics, and flavonoids, which demonstrate remarkable antioxidant properties. These compounds protect cells by neutralizing harmful free radicals, thereby reducing oxidative stress and preventing cellular damage.[15],[23],[21]

2.4.2 Immunomodulatory Effects:

Polysaccharides like β-glucans found in oyster mushrooms are well-known for their immunomodulatory activity. They enhance immune function by stimulating immune cell activity, including the proliferation and differentiation of lymphocytes, which are key to maintaining a healthy immune system[17],[22]

2.4.3 Antimicrobial Properties:

Studies have demonstrated that oyster mushroom extracts exhibit antimicrobial activity against various pathogens. Phenolic compounds and tannins found in these mushrooms contribute to their antibacterial and antifungal effects by disrupting microbial membranes and inhibiting protein synthesis[20]

2.4.4 Prebiotic Potential:

The high dietary fiber content in oyster mushrooms contributes to their prebiotic potential by supporting the growth of beneficial gut microbiota. This not only improves gut health but also enhances overall digestion[16],[18].

2.4.5 Anti-Cancer Properties:

Oyster mushrooms contain bioactive compounds that have demonstrated anti-cancer properties in various studies. Extracts from these mushrooms have shown the ability to suppress tumor growth and inhibit the multiplication of cancer cells. For instance, water extracts of *Pleurotus* species have been effective in reducing the proliferation of MCF-7 human breast cancer cells.[17]

2.4.6 Anti-Inflammatory Effects:

Oyster mushrooms exhibit anti-inflammatory properties that help reduce inflammation under both acute and chronic conditions. Extracts from various *Pleurotus* species have been shown to alleviate inflammatory responses, making them beneficial for managing inflammation- related conditions.[23],[9]

2.4.7 Functional Food Applications:

The functional properties of oyster mushrooms, such as their binding ability and texture- enhancing properties, make them ideal for use in innovative food formulations. They are increasingly incorporated into functional foods like protein bars, meat substitutes, and dietary supplements to meet modern health and sustainability standards[9],[10]

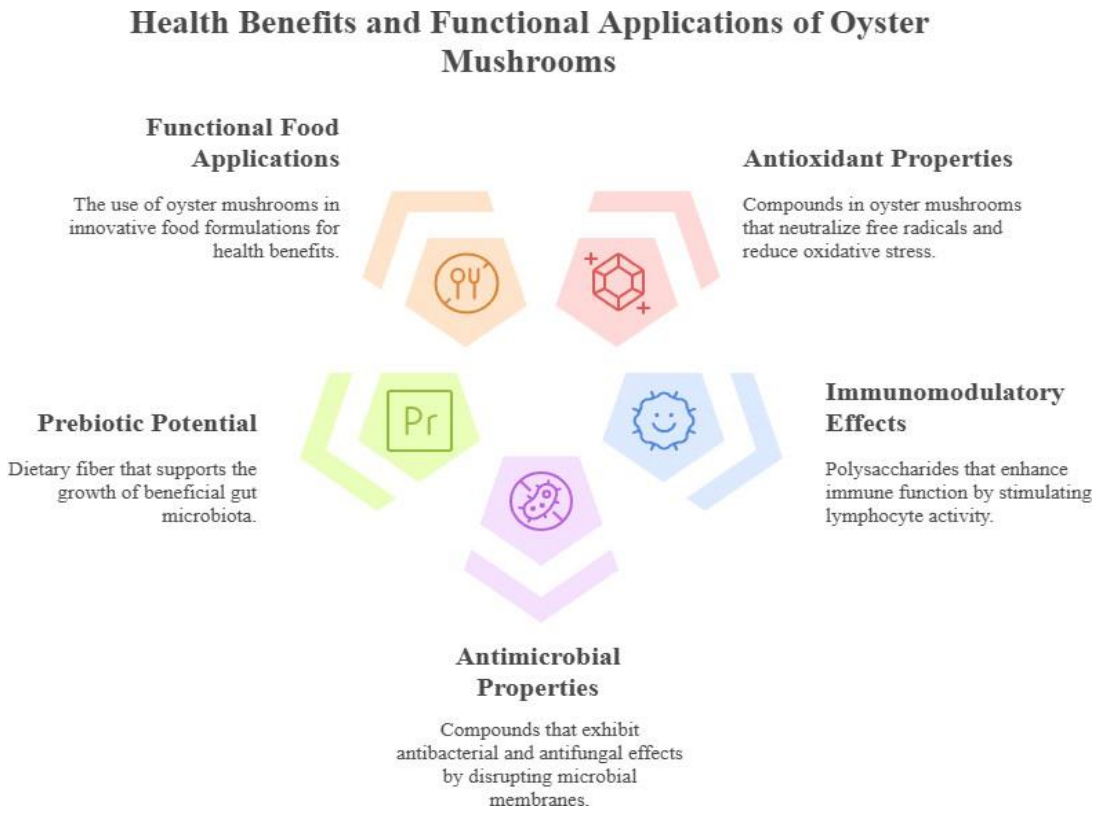

FIGURE 2: Health Benefits of Functional Applications of Oyster Mushroom

2.5 Uses of oyster mushroom:

Oyster mushrooms (Pleurotus spp.) have many uses in the food sector due to their exceptional nutritional and functional qualities. These mushrooms are commonly used as natural flavor enhancers, particularly in vegetarian and vegan meals, because their umami flavor mimics the savory taste of meat. This makes them a necessary component of plant-based substitutes such vegan burgers and sausages[24]. Furthermore, oyster mushrooms are used to boost the nutritional value of a variety of food products, including energy bars, cereals, and supplements, by offering a high concentration of protein, vitamins, and minerals[19]. Their functional properties, such as binding and texture- enhancing abilities, enable their incorporation into innovative food formulations like protein bars and fortified snacks, catering to modern consumer demands for healthy and sustainable food options[9].

Furthermore, oyster mushrooms have antibacterial qualities derived from bioactive chemicals, making them an important element in food preservation. These chemicals prevent the growth of spoilage microorganisms, increasing the nutritional value of both fresh and processed foods [20]. The food sector also uses oyster mushroom fermentation to produce enzymes, organic acids, and bioactive peptides that improve the sensory and nutritional quality of fermented foods and beverages [24]. Overall,

oyster mushrooms' diversity in terms of flavor, nutrition, preservation, and functionality demonstrates their critical role in developing food science and addressing the growing demand for health- conscious and environmentally friendly foods.

2.6 Effective uses of oyster mushroom:

Flavor Enhancement	Oyster mushrooms provide a natural umami flavor, making them ideal for vegetarian and vegan meals. They are commonly used in plant-based substitutes like vegan burgers and sausages.[24]
Nutritional Value	Rich in protein, vitamins, and minerals, oyster mushrooms enhance the nutritional value of food products such as energy bars, cereals, and supplements.[19]
Functional Properties	Their binding and texture-enhancing abilities allow their incorporation into protein bars and fortified snacks, aligning with modern health and sustainability trends[9].
Antibacterial Properties	Bioactive compounds in oyster mushrooms inhibit spoilage microorganisms, aiding in food preservation and maintaining nutritional value[20].
Fermentation Applications	Used in fermentation to produce enzymes, organic acids, and bioactive peptides, which improve the sensory and nutritional quality of fermented foods and beverages.[24]
Overall Role in Food Science	Oyster mushrooms contribute to food innovation by enhancing flavor, nutrition, preservation, and functionality, supporting the demand for health-conscious and eco-friendly foods.

III. CONCLUSION

Oyster mushrooms (Pleurotus spp.) are well-known for their nutritional value, functional characteristics, and multiple uses in the food sector. They include high-quality protein, necessary vitamins, minerals, and bioactive substances, making them perfect for health- conscious individuals and vegans. Their minimal fat and calorie content make them ideal for vegans. Oyster mushrooms have significant antioxidant and anti-inflammatory properties, making them useful for food preservation. They include prebiotic fibers, which enhance gut health and have potential medicinal applications such as immunomodulation, anticancer, and cholesterol-lowering properties. Oyster mushrooms are utilized in plant-based foods, meat substitutes, energy bars, morning cereals, dietary supplements, protein bars, and fortified snacks. They also contribute to fermentation by creating enzymes, organic acids, and bioactive peptides. Oyster mushrooms are a sustainable and environmentally favorable food innovation alternative, surviving on agricultural byproducts and helping to recycle trash. Their variety, health benefits, and environmental sustainability make them essential ingredients in today's diets.

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