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OYSTER MUSHROOM (*PLEUROTUS* SPECIES); A NATURAL FUNCTIONAL FOOD

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ABSTRACT

Oyster mushroom (*Pleurotus* species) is commercially important in the world mushroom market. It is widely cultivated and consumed in different parts of the world. Many people admire the mushroom due to its taste, flavor, high nutritional values, and some medicinal properties. *Pleurotus* are generally rich in proteins with essential amino acids, physiologically important polysaccharides and essential fatty acids, dietary fibers, important minerals, and some vitamins. The presence of some bioactive substances, majorly polysaccharide-protein complex in the genus *Pleurotus* has been reported to confer some pharmacological potential such as antimicrobial, antioxidant, anticancer, anti-inflammation, anti-hypercholesterolemia, anti-hypertensive, anti-diabetic, hepato-protective and anti-allergic activities. The high nutritional value and potential medicinal uses suggest that the oyster mushrooms are pharmacologically important as functional foods.

Keywords: Oyster mushroom, nutritional, medicinal, polysaccharide

INTRODUCTION

Oyster mushroom (*Pleurotus* species) is commercially important in the world mushroom market, and several species are grown commercially on a large and small scale in many countries **(Adebayo *et al.*, 2012a)**. *Pleurotus* species are preeminent wood decomposers, and grow on a wide array of forest and agricultural wastes than species from any other group. They thrive on almost all hardwoods, on wood by-products (sawdust, paper, pulp sludge), all the cereal straws, corn and corn cobs, on sugar cane bagasse, coffee residues (coffee grounds, hulls, stalks, and leaves), banana fronds, cottonseed hulls, agave waste, soy pulp and on other materials too numerous to mention and difficult to imagine. Several species are also capable of acting as parasites of living trees, and attacking nematodes or bacterial colonies.

Mushrooms have long been valued as tasty and nutritional foods, by different societies worldwide. Relationship between mushrooms and man can be traced far back into antiquity. Greatest difficulty in feeding man is to supply a sufficient quantity and quality of the body-building material (protein). The other nutritional categories such as the energy food carbohydrates, fats and accessory food factors (vitamins and inorganic compounds) including water are indispensable to good health **(Adebayo *et al.*, 2014a)**. In terms of the amount of crude protein, mushrooms rank below animal meats, but well above most other foods, including milk, which is an animal product **(Chang and Miles, 2004)**. *Pleurotus* species have been recognized as mushroom with dual functions to humans; both as food and medicine **(Chang and Buswell, 2003)**. They are nutritive with good quantity of proteins, vitamins and minerals. Medicinally, they are been recommended for obese persons and diabetes patients because of low caloric value **(Chang and Buswell, 2003)** and very low sugar without starch.

Traditionally, extracts from *Pleurotus* species have been reported to be used in treating some ailments **(Osemwegie *et al.*, 2010; Idu *et al.*, 2007)**. Most studies in solid culture aim at fruit bodies production. The submerged culture of the genus *Pleurotus* has also been studied by several authors with the most varied objectives including the production of liquid inoculums, extra-cellular enzymes **(Garzillo *et al.*, 1994)**, flavoring agents **(Martin,1992)**, β-glucosidases **(Marois *et al.*, 2002)**, antimicrobials **(Wisbeck *et al.*, 2002)**, vitamins **(Solomko and Eliseeva, 1998)**, and extracellular polysaccharides (EPS) **(Adebayo *et al.*, 2012b)**.

Oyster mushroom was first cultivated by Flank in Germany by 1917. Evolutionary connection among species in the genus *Pleurotus* is still not clear and many taxonomic issues remain controversial. The genus *Pleurotus* is one of the most diverse groups of cultivated mushrooms and shows a typical life cycle of Basidiomycetes. The detailed of taxonomy, life cycle and cultivation of *Pleurotus* species have been reported previously by **Oloke and Adebayo (2015)**.

NUTRITIONAL VALUE OF OYSTER MUSHROOM

The use of mushrooms represents an important cultural heritage as they have been used since time immemorial as food and medicine according to traditional ecological knowledge transmitted along generations **(Pereira *et al.*, 2012)**. Mushrooms are valuable, healthy foods low in calories and high in proteins, vitamins, minerals and have long been valued as highly tasty/nutritional foods. Mushrooms have also been reported as therapeutic foods, useful in preventing diseases such as hypertension, hypercholesterolemia and cancer. These functional characteristics are mainly due to their chemical composition **(Manzi *et al.*, 2001)**. Mushroom fruiting bodies, on a dry weight basis, contain about 39.9% carbohydrate, 17.5% protein and 2.9% fats, the rest being minerals **(Demirba, 2001; Latiff *et al.*, 1996)**. Many consumed mushrooms because of its delicacy, and particularly for their specific aroma and texture. There are several studies available in literature reporting nutrient analysis of mushrooms from Spain **(Díez and Alvarez, 2001)**, Finland **(Mattila *et al.*, 2002)**, Greece **(Ouzouni *et al.*, 2009)**, Italy **(Manzi *et al.*, 2004)**, India **(Agahar-Murugkar and Subbulakshmi, 2005)**, Mexico **(Léon-Guzmán *et al.*, 1997)**, Nigeria **(Aletor, 1995; Adebayo *et al.*, 2014a)**, Portugal **(Heleno *et al.*, 2009)**, Taiwan **(Tsai *et al.*, 2008)**, Tanzania **(Mdachi *et al.*, 2004)** and Turkey **(Yildiz *et al.*,1998)**.

Wild mushrooms are collected for consumption because they are a good source of digestible proteins, carbohydrates, fibres and vitamins **(Barros *et al.*, 2007; Heleno *et al.*, 2009; Kalacˇ, 2009; Ouzouni *et al.*, 2009)**. Structurally, polysaccharides and proteins comprise the main components of dry matter of mushrooms, while the lipid content is low. Chitin, glycogen, mannitol and trehalose are typical carbohydrate constituents. The proportion of essential amino acids is nutritionally favorable, while the content of n-3 fatty acid is negligible **(Kalacˇ, 2009)**.

Many reports have contended that the amino acid compositions of mushrooms are comparable to animal proteins **(Fink and Hoppenhaus, 1958; Gruen and Wong, 1982; Barros *et al.*, 2007)**. This is important, considering the fact that human nutrition has become more complicated since the outbreak of diseases connected with animal meat. The nutritional implications of gradual replacement of meat with mushroom require careful examination which involves detailed chemical and biological studies.

Pleurotus species are considered a good dietary option because of its nutritional value. it is rich in protein, fiber, carbohydrates, vitamins and minerals, and low in content of calories, fats and sodium **(Cohen *et al.*, 2002)** and have pleasant aroma and culinary qualities **(Zadrazil, 1978)**. **Mau *et al.* (1998)** studied the flavor compounds in *P. eryngii* and found them to be mostly volatiles compounds. *Pleurotus* species are rich source of proteins, minerals (Ca, P, Fe, K and Na) and vitamins (thiamine, riboflavin, folic acid and niacin) **(Çağlarırmak, 2007)**. *Pleurotus* sp. contains high potassium to sodium ratio, which makes mushrooms an ideal food for patients suffering from hypertension and heart diseases **(Patil *et al.*, 2010)**. Different nutritional compositions of the *Pleurotus* species have been widely reported. These include proximate analysis **(Ahmed *et al.*, 2013; Adebayo *et al.*, 2014a)**, minerals (macro and micro-nutrient) **(Ahmed *et al.*, 2013; Adebayo *et al.*, 2014a)**, vitamins and growth factors **(Çağlarırmak, 2007)**, amino acid and protein **(Oyetayo and Ariyo, 2013; Masieba *et al.*, 2013)**, and lipid value **(Ahmed *et al.*, 2013)**. Nutritional contents of *Pleurotus* vary according to genetic structure of species, physical and chemical differences in growing medium **(Akyüz and Kirba, 2010)**, composition of the substrate, size of the pileus, and harvest time **(Khan and Tania, 2012).**

PROXIMATE VALUES

Proximate analysis is partitioning of food compounds into six categories based on the chemical properties of the compounds. The six categories are: moisture, ash, crude protein (or Kjeldahl protein), crude lipid, crude fibre, and nitrogen-free extracts (digestible carbohydrates). Proximate value of some *Pleurotus* species is shown in Table1. Dry weight of *P. citrinopileatus* have protein content of 22.10%, fat (1.32%) and fibre of 20.78% **(Musieba *et al.*, 2013)**, whereas **Adebayo *et al.* (2014a)** gave protein value of 34.01%, fat (2.01) and 8.71% of fibre form dry weight of *P. cornucopiae* (Table 1). High value of proteins produced by species of *Pleurotus* is of superior quality because some of the members of this genus contain complete proteins with well distribution of essential amino acids, as well as non-essential amino acids **(Khan and Tania, 2012)**.

The protein content from *Pleurotus* species have compared well with that of several leguminous seeds. Protein evaluation has shown that mushroom proteins have a higher quality than green leafy vegetables **(Adebayo *et al.*, 2014a)**.

Average carbohydrate yield from *Pleurotus* reported in different literature (Table 1) has confirmed the organisms as good source of carbohydrate. A considerable fraction of this carbohydrate is contributed by the presence of oligosaccharides and polysaccharides which contains chitin, α- and β-glucans, and other hemicelluloses(e.g., mannans, xylans, and galactans) **(Synytsya *et al.*, 2008)**. Several of these polysaccharide products have health benefits which includes immunomodulatory **(Jong *et al.*, 1991)**, hematological, antiviral, antitumor, antibiotic and antibacterial activities **(Adebayo *et al.*, 2012b)**.

Appreciable yield of crude fibre present in *Pleurotus* is an indication that incorporating the *Pleurotus* species in diet could aid bowel movement as well as reduce the incidence of colon cancers in its users. Epidemiological studies have found an association between high fibre diets and a lower incidence of cardiovascular diseases and large bowel cancers **(Honda *et al.*, 1999)**. Generally, the low fat content reported confirmed the presence of low calorie value, which is usually recommended for obese persons and diabetes patients **(Chang and Buswell, 2003)**.

MINERAL COMPOSITIONS: MACRO AND MICRO ELEMENTS

Majorly, mineral elements are essential in cell and tissue function of humans and animals **(Koyyalamidi *et al.*, 2013; McDowell, 2003)**.The most essential macronutrient minerals are sodium, magnesium, potassium, phosphorus and calcium, while known essential micronutrient minerals are iron, zinc, selenium, manganese, copper, cobalt, chromium and molybdenum. Macronutrient minerals (calcium, manganese, sodium, phosphorus and potassium) are to maintain acid-base balance, the osmotic regulation of fluid and oxygen transport in the body **(McDowell, 2003)**. In the other hand, micronutrient minerals (zinc, selenium, Molybdenum, iron, copper, vanadium, chromium and cobalt), play major role in the catalytic processes within the enzyme system that includes a wide range of enzyme activities associated with the metabolic, endocrine and immune systems **(Tomkins, 2002; Keen *et al.*, 2004)**.

Genus of *Pleurotus* has been reported as good producer of several mineral components (Table 2). **Musieba *et al.* (2013)** reported that *P. citrinopileatus* predominantly produced potassium with value of 2.28%, while the other minerals such as copper, zinc and iron were produced at very low values of 0.0002, 0.0015 and 0.01% respectively. **Caglarirmak (2007)**, reported the phosphorus values of *P. ostreatus* and *P. sajor-caju* as 998.47 and 716.31 mg/kg respectively, which mean that fruit bodies from *Pleurotus* species can contribute to human nutrition for phosphorous intake; since recommended daily intake of phosphorous is 0.7 g **(Demicri, 2006)**.

Kikuchi *et al.* (1984) reported the value of Zn produced by *Pleurotus* species to be between 12.00 and 18.40 mg/kg whereas, **Adebayo *et al.* (2014a)** reported yield of Zn values obtained from *Pleurotus* species to be between8.91 and 19.01 mg/kg, which is similar to that reported in the literature **(Manzi *et al.*, 1999)**. Research and Development Initiative (RDI) has indicated that an addition of small portion (15 mg for adults and 3–5 mg for babies) of Zn to food material is good for human health and as a result, mushrooms can contribute to human nutrition as a good source of Zn.

Ijeh *et al.* (2009) reported a mean Cu concentration of 0.083 mg/kg in the fruiting bodies of *P. tuber-regium.* The mean Cu concentration of 0.055 mg/g in the pileus (cap) and 0.049 mg/gin the stipe (stem or stalk) of *P. tuber-regium* was also reported in the literature **(Ayodele and Odogbili, 2010)**.The mean concentrations of Co, Cr, and Cu from sclerotia of *P. tuber-regium* were 0.048, 0.18 and 6.9 mg/g, respectively **(Nnorom *et al.*, 2013)**. The adequate intake of Cr is estimatedat 25 mg per day for adults and between 0.1 and 1.0 mg for children and adolescents **(Rose *et al.*, 2010)**. **Krejpcio (2001)** however reported adequate Cr dose for children (>6 years), adolescents, and adults to be between 50 and 200 mg.

The relatively low value of sodium content of 0.03 mg/g (dry weight) in *P. eryngii* was reported by **Gençcelep *et al.* (2009)**, which is a very good nutritional benefit to the consumer **(Vetter, 2003)**. It has been reported that good balance between high content of potassium and low content of sodium may be implicated in curing the high blood pressure **(Manzi *et al.*, 1999)**. **Moda *et al.* (2005)** reported high level of potassium, followed by phosphorus, sodium, calcium, and magnesium from *P. sajor-caju*. **Buswell and Chang (1993)** reported the following values of mineral composition: K (3.3 to 5.3 g/100), P (0.76 to 1.08 g/100), Na (1,650 to 1,840 mg/kg), Ca (200 to 240 mg/kg), and Fe (60 to 2,240 mg/kg) for *P. sajor-caju*.

Table 1 Proximate value of different species of *Pleurotus*

Organisms	**MC**	**AC**	**CP**	**CL**	**CF**	**CC**	**References**
P. cornucopiae	8.36	91.61	34.01	2.01	8.71	9.67	**Adebayo *et al.* 2014** [c]
P. ostreatus	8.70	93.96	21.52	2.77	7.67	5.89	**Adebayo *et al.* 2014** [c]
	88.40	1.41	4.83	0.46	0.63	4.28	**Zahid *et al*. 2010**[d]
P. pulmonarius	7.60	91.70	27.08	3.75	8.52	8.07	**Adebayo *et al.* 2014**[c]
P. sapidus	10.29	92.06	17.77	3.10	7.28	9.21	**Adebayo *et al.* 2014** [c]
P. citrinopileatus	9.12	7.65	22.10	1.32	20.78	3.76	**Musieba *et al.* 2013**[f]
P. sajor-caju	10.2	10.4	26.3	3.7	8.9	ND	**Molehin & O[b] (2011)**[h]
	88.85	1.12	4.20	0.55	0.64	4.65	**Zahid *et al*. 2010**[d]
P. florida	90.07	1.27	3.29	0.41	0.59	4.37	**Zahid *et al*. 2010** [d]
P. highking51	89.54	0.98	4.23	0.43	0.58	4.24	**Zahid *et al.* 2010**[d]
P. tuber-regium	8.88	9.66	6.65	2.24	6.4	66.13	**Onuoha & O[a] (2010)**[e]
	7.4	4.9	13.8	1.1	ND	ND	**Akindahunsi & O[b](2006)**[g]

O[a]= Obi-Adumanya, **O[b]=** Oyetayo, c = (%) of mg/kg of dry weight, d = g/100g fresh weight, e = (%) of dry weight, f = g/100g of dry weight, g = (%) of dry weight, h = (%) of dry weight, ND = not determined; **MC = moisture content, AC = ash content, CP = crude protein, CL = crude lipid, CF = crude fibre, CC =** crude carbohydrates

Table 2 Essential macro and micro minerals of different species of *Pleurotus*

Organisms	Zn	P	K	Mg	Fe	Na	Ca	Cu	Reference
P. cornucopiae	11.25	151.31	120.00	96.73	6.64	68.36	81.16	ND	**Adebayo *et al.* 2014** [a]
P. ostreatus	12.41	105.51	110.56	103.21	8.41	76.06	60.71	ND	**Adebayo *et al.* 2014** [a]
	1.10	ND	ND	0.27	1.76	ND	ND	0.18	**Zahid *et al.* 2010**[e]
	ND	ND	2682.30	166.10	ND	136.00	23.50	ND	**Manzi *et al.* 1999**[d]
	18.40	ND	2020.00	212.00	12.10	10.00	14.00	1.53	**Kikuchi *et al.*1984**[c]
P. pulmonarius	10.36	86.67	69.56	56.91	8.06	74.71	56.91	ND	**Adebayo *et al.* 2014**[a]
	ND	ND	2818.90	183.80	ND	103.40	19.10	ND	**Manzi *et al.* 1999**[d]
P. sapidus	8.91	96.93	93.31	89.61	6.71	89.93	55.99	ND	**Adebayo *et al.* 2014**[a]
P.citrinopileatus	0.00	0.10	2.28	0.07	0.01	0.33	0.02	0.00	**Musieba *et al*. 2013**[b]
P. geesteranus	12.50	8.00	13.00	116.00	431.00	49.00	316.00	3.50	**Ahmed *et al.* 013**[f]
P. florida	0.65	ND	ND	0.17	0.81	ND	ND	0.14	**Zahid *et al.*2010** [e]
*P. highking*51	1.24	ND	ND	0.24	1.40	ND	ND	0.20	**Zahid *et al*. 2010**[e]
P. sajor-caju	0.68	ND	ND	0.19	0.94	ND	ND	0.37	**Zahid *et al*. 2010**[e]
P. eryngii	ND	ND	3095.00	144.40	ND	50.40	33.7	ND	**Manzi *et al*. 999**[d]

ND= not determined, a = (%) of mg/kg of dry weight, b = g/100g of dry weight, c = Zn & Cu (mg/kg), others (g/kg), d = g/100g fresh weight, e = g/100g of dry weight,f = Wet basis µg/g,; Zn = zinc, P= phosphorus, K = potassium, Mg = manganese, Fe = iron, Na = sodium, Ca = calcium, Cu = copper.

FATTY ACID COMPOSITION

Fatty acids are structurally characterized as straight-chain mono-unsaturated and polyunsaturated with branched chain building blocks of dietary fats and oils. They have potential of regulating lipid metabolism at different levels **(Wolfrum and Spener, 2000)**. The essential fatty acids (EFA), linoleic and linolenic acids are two long-chain fatty acids that are fundamental to human diets. Total fat or lipid content production varied from one species of *Pleurotus* to the other **(Nieto and Chegwin, 2013)**. So also, distribution of fatty acids varied amongst different species of the *Pleurotus*. **Nieto and Chegwin (2013)** reported different components and concentrations of the fat fraction calculated based on percentages of total ion chromatogram (TIC) for *P. ostreatus, P. pulmonarius* and *P. sajor-caju*. The highest reported value was Linoleic acid (19.1%) by *P. ostreatus,* followed by palmitic acid (18.4%) by *P. pulmonarius* and linoleic acid (13.5%) in *P. sajor-caju.* Several other fatty acids produced by these organisms are pentadecanoic acid, stearic acid, oleic acid, methyl hexadecanoate, ethyl hexadecanoate, methyl 8,11-octadecadienoate and ethyl linoleate; **(Nieto and Chegwin, 2013)**.

P. ostreatus was reported by **Hadar and Cohen-Arazi (1986)** to produce fatty acids such as palmitic, stearic, oleic, linoleic, and lauric **(Hadar and Cohen-Arazi, 1986; Yilmaz *et al*., 2006 and Hashem *et al*., 2013)**.Fatty acids such as saturated, mono-unsaturated (including the oleic acid), polyunsaturated (including the linoleic acid) were also produced by *P. djamor* and *P. sajor-caju* **(Kavishree *et al*., 2008)**.

Other mushrooms species have been reported as good producer of fatty acids **(Senatore *et al*., 1988; Hiroi and Tsuyuki, 1988; Takenaga *et al*., 1988; Solomko *et al*., 1984; Kwon and Uhm, 1984; Nam and Ko, 1980)**. The efficient production of the fatty acids especially linolenic and oleic acids which are majorly needed in building blocks of dietary human has confirmed *Pleurotus* species as good source of nutrition.

AMINO ACID COMPOSITION

Amino acids (AA) have traditionally been classified as nutritionally essential (indispensable) or nonessential (dispensable) for animals and humans **(Baker, 2009; Wu, 2009)**. Nutritionally essentials AA (EAA) are those whose carbon skeletons are not synthesized by animal cells and, therefore, must be provided from the diet. Proteins are made up from over 20 amino acids in varying amounts and they are quantitatively different. The human body can convert some of these amino acids into others, but there are nine essential amino acids (lysine, methionine, tryptophan, threonine, valine, leucine, isoleucine, histidine, and phenylalanine), which must be present simultaneously and in correct relativeamounts for protein synthesis to occur. Dietary essentiality of some AA (e.g. arginine, glycine, proline) depends on species and developmental stage **(Wu, 2009)**.On the other hand, nonessentials AA (NEAA) are those AA that are synthesized de novo in a species-dependent manner **(Watford, 2008; Wu *et al*., 2009)**. Major functions of AA are to regulate key metabolic pathways to improve health, survival, growth, development, lactation, and reproduction of organisms **(Wu, 2009)**.

Animal cells have been implicated as major producers of essential amino acids, but interestingly, a lot of mushroom species especially *Pleurotus* have been found to produced them in large quantity. **Musieba *et al.* (2013)** reported the production of all essential amino acid from the fruit body of *P. citrinopileatus,* whereas, Hadar and Cohen-Arazi (1986) reported the production of essential amino acid from mycelium and fruit body of *P. ostreatus* and *P. florida.* The 20 amino acids have been obtained from fruit body of *P. ostreatus* **(Hashem *et al*., 2013; Oyetayo and Ariyo, 2013)**. The fruit body of *P. ostreatus* and *P. sajor-caju* were found to be rich in asparagine; aspartic acid as well as glutamic acid but poor in proline; glycine, as well as methionine **(Chirinag and Intarapichet, 2009)**.The evidence from the literature shows that a very good number of *Pleurotus* are versatile in the amino acids production, which means they may be good replacement for protein from meats (See Table 3 for details).

VITAMINS COMPOSITIONS IN *PLEUROTUS*

Edible mushrooms have been reported to be a good source for several vitamins including thiamine (vitamin B_1), riboflavin (vitamin B_2), niacin, biotin, and ascorbic acid (vitamin C). *P. citrinopileatus* has been reported to contain the following vitamins in abundance: B_3 (nicotinic acid), B_5 (pantothenic acid), B_2 (riboflavin), B_1 (thiamine), B_6 (pyridoxine), B_7 (biotin) and B_9 (folic acid), but with less abundance of vitamin B_{12} (cyanocobalamin), vitamin C (ascorbic acid) and vitamin A (retinol) **(Musieba *et al*., 2013)**. Maximum amount of vitamins E, A and C were produced from fresh fruit bodies of *P. ostreatus* with the following values:- vitamin E (7.23 mg/g), vitamin A (0.363 mg/g) and vitamin C (0.363 mg/g) **(Kumari and Achal, 2008)**. Production of thiamine (1.16 to 4.80) and niacin (46.0 to 108.7) in mg per 100 g dry weight of *Pleurotus* species have been described **(Chang and Miles, 2004)**. **Lau *et al.* (1985)** reported the ascorbic acid content from fruit body of *P. sajor-caju* as 7.4 mg per 100 g dry weight. The nutritional attributes of oyster mushroom stated above hold tremendous promise in complementing the human diet. Consumption of these mushroom products could be nutritionally and medicinally beneficial to human.

PHARMACOLOGICAL IMPORTANCE OF OYSTER MUSHROOM

Edible mushrooms have long been considered to have medicinal value, while being devoid of undesirable side-effects **(Sagakami *et al*., 1991)**. The first documented information about medicinal value of mushrooms was in 100AD in China **(Gunde-Chimerman, 1999)**. Mushrooms have received increasing attention from the researchers in food and pharmaceuticals, because many species have long been used in traditional medicines or functional foods in different parts of the world. One of the prominent species of edible mushroom with valuable medicinal important is *Pleurotus* which have been recognized as mushroom with dual functions to humans; both as food and medicine **(Chang and Buswell, 2003; Adebayo *et al*., 2012b).**

Traditionally, extracts from *Pleurotus* species have been reported to be used in treating some ailments in different parts of Nigeria **(Osemwegie *et al*., 2010; Idu *et al*., 2007)**, China, Japan and other Asian countries **(Xu *et al*., 2011)**. During the past three decades, many polysaccharides and polysaccharides-protein complexes have been isolated from fungi, such as homogeneous and heterogeneous polysaccharides, glycans, and glycan-protein complexes which have been shown to promote good health **(Jong, 2002)**. Many of these biologically active polysaccharides have been known to exhibit haematological,

antiviral, antitumour, antibiotic, immunomodulating, antioxidant, antimicrobial and anti-inflammatory activities **(Cohen *et al.*, 2002; Hamzah *et al.*, 2014; Adebayo *et al.*, 2014b; Khan and Tania, 2012).**
Mushrooms accumulate a variety of secondary metabolites, including phenolic compounds; polyketides, terpenes and steroids **(Adebayo *et al.*, 2012b)**. Also, a mushroom phenolic compound has been found to be an excellent antioxidant and synergist that is not mutagenic **(Ishikawa *et al.*, 2001).** Phytochemical screening of the *Pleurotus* spp. extract have revealed the presence of alkaloids, saponins, steroids, phlobatannins, flavonoids, terpenes, phenols, tannin and anthraquinones **(Adebayo *et al.*, 2012a; Hamzah *et al.*, 2014)**.

Table 3 Amino acid profile from *Pleurotus* species

Amino acid	P. o	P. o	P. c	P. p	P. f	P. s	P.s
Alanine	0.23	3.75	0.86	6.35	ND	1.80	ND
Arginine	0.64	6.30	1.01	4.82	ND	2.52	ND
Aspartic acid	1.37	4.30	1.82	9.65	ND	2.01	ND
Glutamic acid	1.53	10.2	3.07	18.24	ND	4.22	ND
Glycine	0.09	1.65	0.84	5.99	ND	0.96	ND
Histidine	0.56	1.10	0.51	2.17	2.80	0.52	2.20
Isoleucine	0.29	1.26	0.61	4.41	5.20	0.75	4.40
Leucine	0.98	2.31	1.07	7.96	7.50	1.30	7.00
Lysine	0.64	1.50	0.81	4.54	9.90	0.78	5.70
Methionine	0.08	0.53	0.30	2.30	3.00	0.34	1.80
Phenylalanine	0.75	ND	0.65	3.72	3.50	0.86	5.00
Proline	0.10	ND	0.33	4.98	ND	0.33	ND
Threonine	1.16	ND	0.83	6.57	6.10	0.98	5.00
Tryptophan	0.11	ND	0.28	ND	1.10	0.09	1.20
Tyrosine	0.18	ND	0.58	3.00	ND	0.67	ND
Valine	0.24	ND	0.85	5.93	6.90	0.98	5.30
Cysteine	0.06	0.53	0.20	2.25	ND	ND	ND
Serine	0.12	ND	1.03	7.12	ND	0.99	ND
Reference	**a[1]**	**a[2]**	**a[3]**	**a[4]**	**a[5]**	**a[6]**	**a[7]**

a[1] = **Hashem *et al.*, 2013** (mg/g fresh weight), a[2] = **Oyetayo and Ariyo, 2013** (g/100g), , a[3] = **Masieba *et al.*, 2013** (%), a[4] = **Adebayo, 2013** ((g/100g protein dry weight), a[6] = **Chirinang and Intarapichet, 2009** (mg/g fresh weight), a[5] & a[7] = **Crisan and Sands, 1978** (aa/100g of corrected crude protein); P. o = *P. ostreatus*, P. s = *P. sajor-caju*, P. c = *P. citrinopileatus*, P. p = *P. pulmonarius*, P. f = *P. florida.*

These alkaloids and saponins which could be toxic at high doses were found to occur in non-toxic doses. Alkaloids have been reported as a group of basic organic substances of plant and microbial origin, containing at least one nitrogen atom in a ring structure in the molecule. The presence of saponins, tannins, alkaloids and steroids in the mushroom extract is an indication that they are of pharmacological importance **(Adebayo *et al.*, 2012a)**.

ANTIOXIDANT PROPERTY

Antioxidant compounds prevent oxidative damage related to aging and diseases, such as atherosclerosis, diabetes, cancer and cirrhosis **(Khan *et al.*, 2010)**.Stress on the body due to aging, obesity, and detrimental lifestyle choices is another significant health issue, which often takes the form of oxidative damage to tissues. Superoxide radicals, hydroxyl radicals and hydrogen peroxide damage DNA, impair enzymes and structural proteins, and provoke uncontrolled chain reactions including lipid peroxidation **(Halliwell and Cross, 1994; Ren *et al.*, 2014)**.Free radicals are types of Reactive Oxygen Species (ROS), which include all highly reactive, oxygen-containing molecules, the hydroxyl radical, the superoxide anion radical, hydrogen peroxide, singlet oxygen, nitric oxide radical, hypochlorite radical, and various lipid peroxides **(Adebayo *et al.*, 2014b)**. All these are capable of reacting with membrane lipids, nucleic acids, proteins and enzymes and other small molecules, resulting in cellular damage **(Adebayo *et al.*, 2014b).**
In living organisms, various ROSs can be formed in different ways, such as normal aerobic respiration, stimulated polymorphonuclear leukocytes and macrophages and peroxisomes. These appear to be the main endogenous sources of most of the oxidants produced by cells. Exogenous sources of free radicals include tobacco smoke, ionizing radiation, certain pollutants, organic solvents and pesticides **(Adebayo *et al.*, 2012a; Adebayo *et al.*, 2014b).**
Most commonly used synthetic antioxidants are butylated hydroxyanisole (BHA), butylated hydroxyltoluene (BHT), propyl gallate and tert-butylhydroquinone. However, the use of BHA and BHT has been restricted in foods as they are suspected to be carcinogenic and to cause liver damage **(Sherwin *et al.*, 1990; Jayakumar *et al.*, 2011)**. Hence, there is need for an alternative means of antioxidants, which has resulted to growing interest using natural additives as potential antioxidants. Mushrooms have been discovered to be the primary source of ergothioneine (ERG), a naturally occurring thiol containing amino acid, known for its antioxidant properties **(Dubost *et al.*, 2006; Jayakumar *et al.*, 2011)**. Mushrooms that contain antioxidants or increase antioxidant enzyme activity may be used to reduce oxidative damage in human **(Adebayo *et al.*, 2014b)**.
Mushroom are rich in natural substances, such as vitamins A, C and E, carotenoids, flavonoids and other simple phenolic compounds, which are proven to prevent oxidative damage and thus protect the human body **(Ren *et al.*, 2014).** Inherently, mushrooms produced variety of secondary metabolites, which have been shown to act as excellent antioxidants **(Woldegiorgis *et al.*, 2014)**.Polysaccharide–peptide complex (F22) from *Pleurotus abalones* fruiting bodies has been well documented to have antioxidant effects (Li *et al.*, 2007). The *in vitro* analysis of ethanolic extract of the *P. ostreatus*, has proved to be potent antioxidant activity by its scavenging hydroxyl and superoxide radicals, inhibiting lipid peroxidation, reducing power on ferric ions and chelating ferrous ions **(Nau, 1998; Jayakumar *et al.*, 2011)**. Likewise, *P. ostreatus* ethanolic extract also exhibits good *in-vivo* antioxidant activity by reducing the intensity of lipid peroxidation and by enhancing the activities of enzymatic and the levels of non-enzymatic antioxidants **(Jayakumar *et al.*, 2011)**.
Adebayo *et al.* (2014b) reported the *in vitro free radical scavenging activities* of methanolic extract from *P. pulmonarius, P. cornucopiae, P. sapidus* and *P. ostreatus* against 1,1-diphenly-2-picrylhydrazyl (DPPH) and β-carotene-linoleate model. Polyphenolic compounds have an important role in stabilizing lipid oxidation and are associated with antioxidant activity **(GulcinBuykokuroglu *et al.*, 2003)**. Great scavenging effect against DPPH in comparison withbutyl hydroxytoluene (BHT), butylated hydroxyanisole (BHA) and tert-butylhydroquinone (TBHQ) was observed in petroleum ether (PE) extract from *P. porrigensat* and *P. florida* by **Wong and Chye (2009)**. The consistent antioxidant activities reported in literature by the *Pleurotus* spp may be due to high phenol, flavonoid and other antioxidant phytochemicals present in the mushroom extracts **(Patel *et al.*, 2012).**

ANTIMICROBIAL ACTIVITY

Natural antimicrobials can be obtained from different sources including plants, animals, bacteria, algae and fungi. Bioactive substances of several mushrooms (*Pleurotus* species) have showed antibacterial, antifungal, antiviral, and antimicrobial activities. Several studies related to mushroom antimicrobials have demonstrated the efficacy of extract or polysaccharide compounds from oyster mushrooms **(Gyawali and Ibrahim, 2014; Ren *et al.*, 2014; Adebayo *et al.*, 2012b; Neelam and Singh, 2013)**. Antimicrobial activity of mushrooms may be attributed to the presence of various bioactive secondary metabolites, protein-polysaccharide compounds, some phenols, some phytochemicals, free fatty acids and their derivatives **(Bala *et al.*, 2012; Gyawali and Ibrahim, 2014)**. Thus mushrooms producing these bioactive components could support applications in the pharmacological industry as an effective source of natural substances that could be used in drug discoveries.

The polysaccharide extract from *P. australis* showed antibacterial activity against *Staphylococcus epidermidis, Bacillus subtilis, Enterococcus faecalis, Escherichia coli*916 and *Enterobacter aerogenes* **(Ren *et al.*, 2014)**. Polysaccharide with α and β-D- type linkage from *P. pulmonarius* have antagonistic effect against *Proteus mirabilis, Salmonella typhi, Staphylococcus aureus, E. coli, Shigella species* and *Klebsiella pneumonia* **(Adebayo *et al.*, 2012a)**. The *P. tuber-regium* extract had powerful medicinal importance by inhibiting the growth of *Bacillus cereus, E. coli, K. pneumoniae, S. aureus, Proteus vulgaris,* and *P. aeruginosa* **(Gbolagade *et al.*, 2007)**.Several reports are available in the literature with antimicrobial activity of extracts from genus of *Pleurotus* such as, *P. florida* and *P. ostreatus* **(Neelam and Singh, 2013; Muthukumaran *et al.*, 2014)**, *P. sajor-caju* and *P. ostreatus* **(Mondal *et al.*, 2013)**, *P. eryngii* **(Akyuz and Kirbag, 2010)**, *P. ostreatus* **(Oyetayo and Ariyo, 2013; Domenico *et al.*, 2013; Vamanu, 2012, 2013; Pauliuc and Botău, 2013; Iwalokun *et al.*, 2007)**, *P. eryngii* and *P. sajor-caju*, **(Akyuz and Kirbag, 2010), *P. florida* (Rahman *et al.*, 2013; Menaga *et al.*, 2012)**, see Table 4 for details.

The RNase from *P. sajor-caju* inhibited mycelial growth in the fungi *F. oxysporum* and *M. arachidicola* **(Ngai and Ng, 2004)**. A protein of 10 kDa, designated as eryngin was isolatedfrom*P. eryngii*, which showed inhibition of mycelial growth in *F. oxysporum* and *M. arachidicola* **(Chu *et al.*, 2005)**. A 7-kDa peptide, named pleurostrin, with inhibitory activity on mycelial growth inthe fungi *Fusaerium oxysporum, Mycosphaerella arachidicola*, and *Physalospora piricola*, was isolated from fresh fruit bodies of the *Pleurotus* species **(Wang and Ng, 2004; Patel *et al.*, 2012)**.

A purified laccase from *P. ostreatus* inhibited the hepatitis C virus entry into peripheral blood cells and hepatoma HepG2 cells, and its replication **(El-Fakharany *et al.*, 2010)**. A different type of laccase was purified from *P. cornucopiae*, which reduced the activity of human immunodeficiency virus type 1 (HIV-1) reverse transcriptase with an IC_{50} of 22μM **(Wong *et al.*, 2010)**. A lectin from fresh fruit bodies of *P. citrinopileatus* inhibited HIV-1 reverse transcriptase with an IC_{50} of 0.93μM **(Li *et al.*, 2008)**.

Table 4 Antimicrobial activity of *Pleurotus* species

Organism	Bioactive substance	Target organism	References
P. australis	Polysaccharides with glycosidic linkage	*B. subtilis, E. faecalis, E. coli, E. aerogenes, S. epidermidis*	**Ren *et al.*, 2014**
P. florida	methanolic extract	*K. pneumonia,S.aureus,*	**Muthukumaran *et al.*, 2014**
	ethanolic extract	*Bacillus sp., S. aureus,*	**Rahman *et al.*, 2013**
	methanolic extract,	*E. coli, K. pneumonia,*	**Menaga *et al.*, 2012**
	aqueous extract,	*Vibrio sp., Streptococcus sp.,*	
	phytochemicals.	*Campylobacter sp., S. typhi, S. sonnei, Proteus sp.*	
	ethanolic extracts,	*E. coli, S.aureus, B.subtilis*	**Neelam & Singh, 2013**
P. eous	phytochemicals	*P. aeruginosa, A.nidulans, A. fumigatus*	**Muthukumaran *et al.*, 2014**
P. ostreatus	ethanolic extract,	*L. innocua, B. cereus,*	**Vamanu, 2012, 2013**
	Phenolics, Flavonoids	*S. aureus, E. coli,*	**Schillaci *et al.*, 2013**
	Ascorbic acid, Lycopene, β-carotene, α-tocopherol.	*P. aeruginosa,C. albicans, Candida sp.*	
	gemmotherapic extract	*B. subtilis, B. cereus, P. aeruginosa, S. marcescens*	**Pauliuc&Botău, 2013**
P. ostreatus	flavonoid, vitamin-C,	*Vibrio cholera, Bacillus spp.*	**Mondal *et al.*, 2013**
	petroleum ether extract, Terpenoids, Tanins, Steroidal glycosides.	*S. aureus, S. epidermidis, B. subtillis, B. licheniformis, S. typhi, E. coli, Proteus sp. K. pneumonia,P. aeruginosa, H. influenza, C. albicans Saccharomyces cerevisiae.*	**Iwalokun *et al.*, 2007**
	petroleum ether extract, Terpenoids, Tanins, Steroidal glycosides.	*S. aureus, S. epidermidis, B. subtillis, B. licheniformis, S. typhi, E. coli, Proteus sp. K. pneumonia,P. aeruginosa, H. influenza, C. albicans Saccharomyces cerevisiae*	
P. eryngii	methyl alcohol extracts	*B. megaterium, S. aureus, P. sajor-caju, K. pneumonia, E.coli, C. albicans, C. glabrata, Trichophyton spp., Epidermophyton spp*	**Akyuz & Kirbag, 2010**
	methanolic extract,	*S. aureus, E. coli,*	**Mondal *et al.*, 2013**
P. pulmonarius .	polysaccharide with α and β-D- type linkage phytochemicals	*P. mirabilis, P. aeruginosa, S. typhi, S. aureus, E. coli, Shigella sp., K. pneumonia.*	**Adebayo *et al.*, 2012b**

The use of *P. djamor, P. sajor-caju,* and *P. citrinopileatus* mushrooms as food and therapeutic substances, particularly in HIV/AIDS (human immunodeficiency virus/acquired immunodeficiency syndrome)–infected persons, was highly encouraged in a study, as their methanolic extracts showed strong antiviral activity against HIV. *P. djamor* extracts also have stronger antiviral activities against both pox virus and infectious bursa disease virus. Some water-insoluble fractions, extracted by hot alkali treatment from the sclerotia of *P. tuber-regium*, showed potent antiviral activity againstHSV-1 (herpes simplex virus 1) and HSV-2 **(Zhang *et al.*, 2004)**.

ANTI-INFLAMMATION ACTIVITY

The Polysaccharide with α and β-D-linkage extracted from *P. pulmonarius*, was found to be a potent anti-inflammatory agent **(Adebayo *et al.*, 2012b)**. Also the aqueous extract of *P. ostreatus* suppressed LPS-induced secretion of tumor necrosis factor-α (TNF-α), interleukin-6 (IL-6), and IL-12p40 from RAW264.7 macrophages **(Jedinak *et al.*, 2001)**. In addition anti-inflammatory activity of extract from *P. ostreatus* was reported against an ear acute inflammation stimulated by xylol on white underbred rat-male **(Avagyan *et al.*, 2013)**. Similarly; a purified protein called Pleuran, isolated from fruiting bodies of oyster mushroom has been reported to possesses anti-inflammatory activity **(Bobek and Galbavy, 2001; Nosál'ová *et al.*, 2001).**

ANTICANCER EFFECTS

Mushrooms produced some bioactive compounds such as 1,6-branched 1,3-β-glucans which have been reported to inhibit tumor growth by stimulating the immune system via activation of macrophages, balance of T helper cell populations and subsequent effects on natural killer (NK) cells and also by cytokine production **(Hetland *et al.*, 2011; Roupas *et al.*, 2012)**.Water-soluble extract from *P. ostreatus* showed significant cytotoxicity, and induced apoptosis in human androgen-independent prostate cancerPC-3 cells **(Gu and Sivam, 2006)**. Hot water extract of *P. ostreatus* also suppressed proliferation of MCF-7 human breast cancer cells **(Martin and Brophy, 2010)**.

Jedinak and Silva (2008) reported an anticancer effect of methanol extract of *P. ostreatus* on some breast and colon cancer cells. The extract suppressed proliferation of breast cancer (MCF-7, MDA-MB-231) and colon cancer (HT-29, HCT-116) cells, without affecting proliferation of epithelial mammary MCF-10A and normal colon FHC cells. Flowcytometry analysis revealed that the inhibition of cell proliferation by *P. ostreatus* was associated with the cell cycle arrest at G0/G1 phase in MCF-7and HT-29 cells. Furthermore, *P. ostreatus extract* induced the expression of the tumor suppressorp53 in MCF-7 cells, and cyclin-dependent kinase inhibitor p21 in both MCF-7 and HT-29 cells **(Khan and Tania, 2012)**.

The protein extract of *P. ostreatus* has exhibited therapeutic efficacy against human colorectal adeno-carcinoma cell line (SW 480 cells)and a human monocytic leukemia cell line (THP-1cells) by induced apoptosis in SW 450 cells partially through Reactive Oxygen Species (ROS) production, Glutathione (GSH) depletion and mitochondrial dysfunction **(Wu *et al.*, 2011; Deepalakshmi and Mirunalini, 2014)**.

Polysaccharide extracts from mycelium and fruit bodies of *P. pulmonarius* down-regulated the adherence of colon cancer cell lines (HT29, HCT-116), which directly interfere with cancer progression and metastasis **(Lavi *et al.*, 2010).** Polysaccharides from hot water extract of *P. geesteranus* have showed significant cytotoxicity in human breast cancer cell line MCF-7**(Zhang *et al.*, 2011)**. Acetone extract from *P. pulmonarius* and *P. ostreatus* exhibited a profound anticancerpotential as they offered protection to animals by tumour suppressor **(Akanni *et al.*, 2010).**

Water-soluble polysaccharides extracted from *P. citrinopileatus* fermentation broth have been shown to reduce the number of metastatic tumour nodules in tumour-bearing mice **(Wang *et al.*, 2005)**. The protein-polysaccharide from *P. ostreatus and P. sajor-caju* inhibited a solid Sarcoma180 tumor implanted in mice **(Facchini *et al.*, 2014)**.Major component behind the anticancer activity of *Pleurotus* mushrooms is its polysaccharide fraction called pleuran, a member of polysaccharide beta glucans, which is an important constituent of *Pleurotus* species. Table 5 summarized detail of *Pleurotus* extracts with potential anticancer nutraceuticals. It should be noted that clinical evidence of anticancer activities of *Pleurotus* mushrooms has not been well established.

IMMUNOMODULATORS

Immunomodulators are key components in the modern health and wellness industries, reflecting the fact that the immune system is the first barrier for disease prevention. Inany healthy organism, the immune system produces a wide range of immunomodulators to maintain homeostasis within the body **(El Enshasy and Hatti-Kaul, 2013)**. In clinical practice, immunomodulators are usually classified into immunosuppressants, immunostimulants, andimmunoadjuvants. Polysaccharides from mushrooms such as lentinan, schizophyllan, polysaccharide K (Kerstin), and polysaccharide peptide (PSP) are now available on the pharmaceutical market. For example, lentinan is applied as adjuvant cancer immunotherapy or in parallel to radio- and chemothermotherapy **(Lindequist *et al.*, 2005)**. Protein from oyster mushroom (*P. ostreatus*) called pleuran together with proteoglycan has been shown to posses immunomodulators by inducing IL-4 and IFN-γ production in animal cell **(El Enshasy *et al.*, 2012).** Water extract from fruit bodies and mycelia of *P. ostreatus* has been reported to play a major role in increasing the production of reactive oxygen species (ROS) from neutrophil and has immunomodulatory properties involving all immunocompentent cells **(Shamtsyan *et al.*, 2004)**.

Morris *et al.* (2011) reported that *Pleurotus* powder and hot water extract obtained from fruit body, administered orally to cyclophosphamide-treated mice, provides immunological benefits in terms of the recovery of bone marrow cellularity, increase of white blood cell counts, and stimulation of cell-mediated immune responses. Polysaccharides or polysaccharide-protein complexes are considered as multi-cytokine inducers that are able to induce gene expression of various cytokines and cytokine receptors **(Ooi and Liu, 2000)**. A thorough understanding of immunomodulatory actions of polysaccharides or polysaccharide-protein complexes at the cellular and molecular levels will help elucidate their anti-tumor mechanisms.

Table 5 Properties and mechanisms of bioactive compounds from *Pleurotus* extract against human cancers cell lines

Mushroom	Bioactive extract	Disease state (Anticancer)	Mechanism	References
P. geesteranus	Polysaccharide-protein	(Breast) (MCF-7 cell)	Mechanism not clearly stated	**Zhang *et al.* (2011)**
P. ostreatus	Flavonoids	(Blood)	Cytotoxic effect on human cancer cell lines (HL-60) in vitro	**Maiti *et al.* (2011)**
	Polysaccharide β-glucan	(Colon)	Induces anti-proliferative and pro-apoptotic effects on HT-29 colon cancer cells	**Lavi *et al.* (2006)**
	Hot water extract	(Breast)	Suppression in proliferation of MCF-7 human breast cancer cells	**Martin & Brophy, 2010**
	Methanol extracts	(Breast)	Suppression of the proliferation of highly invasive breast cancer MDA-MB-231 cells	**Jedinak & Sliva, 2008**
		(Colon)	Inhibited the proliferation of highly-invasive colon cancer HCT-116 cells	**Jedinak & Sliva, 2008**
P. cornucopiae	Laccase	(Murine)	Proliferation inhibitory Leukememia (L1210 cell) activity of laccase Hepatoma (HepG2 cell)	**Wong *et al.* (2010)**
P. djamor	Ribonuclease	(Breast and Hepatoma)	Regulation of proliferative genes by RNase activity	**Wu *et al*. (2010)**
P. eryngii	Ubiduinone-9	Anticancer	Inhibition of DNA topoisomerase I, and induction of apoptosis	**Bae *et al.* (2009)**
P.citrinopileatus	Glycoprotein	(Leukemia U937 cell)	Anti-proliferation and (Leukemia U937 cell) arrested of cell cycle	**Chen *et al.* (2009)**
P.nebrodensis	Nebrodeolysin	Anticancer	Induction of apoptosis (lung, breast, hepatoma and cervical)	**Lv *et al.* (2009)**
P. tuber-regium	Triterpenoids, Hyper-branched	(Liver)		**Youn *et al.* (2008)**

	β-glucan		Exhibit tumour selective cytotoxicity (in vitro)	
		(Liver)	Hepato-protective effects on both chemically-induced liver toxicity and hepatocarcinogenesisin rodents (in vivo)	**Wasonga *et al.* (2008),** **Pinheiro *et al.* (2008).**
P. ferulae		(Lung and cervical)	Exhibit cytotoxic effects on human lung and cancer cell lines (A549, SiHa and HeLa cells) (in vitro)	**Choi *et al*. (2004)**

OTHER THERAPEUTICS IMPORTANCE

Genus of *Pleurotus* has shown hypoglycemic activities, which is a major feature of diabetes mellitus, hence they have anti-diabetic effect on animals and human. Polysaccharides extract with anti-diabetic potential have been obtained from *P. ostreatus* **(Krishna and Usha, 2009)**, *P. citrinopileatus* **(Hu *et al.*, 2006)**, *P. eryngii*, **(Kim *et al.*, 2010)**, *P. pulmonarius* **(Badole *et al.*, 2008)** and *P. sajor-caju* **(Agrawal *et al.*, 2010)**.

The polysaccharides from fruiting bodies of *P. ostreatus* **(Bobek *et al.*, 1998; Wolff *et al.*, 2008)**, *P. sajor-caju* **(Zhuang *et al.*, 1993)**, and *P. citrinopileatus* **(Zhang *et al.*, 1994)** have been reported to have antineoplasic activities. In addition ethanol extract of *P. eryngii* has been reported to have antiallergic activity **(Sano *et al.*, 2002)**. Also antihypertensive activity of *Pleurotus* has been reported in the literature **(Miyazawa *et al.*, 2008; Hagiwara *et al.*, 2005).**

CONCLUSIONS

Presently, there is upsurge interest in research for nutraceuticals and natural source of remedies. Most of the researchers are anticipating that nutraceutical therapy is a promising source of new therapeutics against many life-threatening diseases. Oyster mushrooms have notable place in nutraceutical science, which are rich nutritionally, with medicinal values, especially as antioxidant, antimicrobial, anti-inflammation, anticancer, immunomodulators, anti-diabetes, antineoplasic, and antihypertensive. The above properties reported suggested that oyster mushroom can serve as good source of antibiotic production, anticancer drugs and immunity boasters. Furthermore, high production of nutritional composition such as protein, amino acids, vitamins, minerals and low production of fat and sugar may provide significant support against malnutrition disease. The current nutrient deficiency and health problems all over the world may be brought under control by regular consumption of *Pleurotus.* This can also play important role in health and disease prevention. More clinical researches are suggested to authenticate the mechanism, pathways, and doses of medicinal component of the oyster mushroom.

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