Available at www.ijcasonline.com ISSN 2349 – 0594

International Journal of Modern Chemistry and Applied Science

International Journal of Modern Chemistry and Applied Science 2015, 2(2), 78-86

Nutrient Contents of Edible Mushrooms, *Agaricusbisporus* and *Pleurotusostreatus.*

G.K. Poongkodi[1] G.P.HarithraPriya[2] and G.P.Harshitha Priya[2]

[1]*Department of Biochemistry, Dr. ALM P.G. Institute of Basic Medical Sciences, University of Madras, Taramani, Chennai – 600 113, Tamil Nadu, South India.*
[2]*GRT MahalakshmiVidyalaya Matriculation Higher Secondary School, Chennai-83.Tamil Nadu.*

Correspondence Author: Department of Chemistry, College of Natural and Computational Studies, Ambo University, Ambo, Ethiopia; Tel:+251939230629 Email address: gkpoongkodi@gmail.com

Abstract:

The aim of the present work is to measure the nutrient and trace minerals concentrations in two parts of the mushroom species, *Agaricusbisporus* and *Pleurotusostreatus. Agaricusbisporus* were collected from the spawn producing centres, Chennai, Tamilnadu, South India. The pileus and stipes of the mushrooms were separated and analysed individually. The total lipid content of fresh and dry weight basis of *Agaricusbisporus* were highly significant when compared with *Pleurotusostreatus*. The minerals like nitrogen total and calcium, copper, iron, inorganic phosphorus, magnesium, manganese, nickel, phosphorus, silicon and titanium were found to be higher in pileus than stipes, while alumina, lead, potassium, sodium, selenium and zinc were found higher in stipes than pileus.

Keywords: *Agaricusbisporus, Pleurotusostreatus,* pileus, stipes and mushroom.

1. Introduction:

The objective of the study is to investigate the nutrient and trace minerals concentrations in two parts of the mushroom species,*Agaricusbisporus* and *Pleurotusostreatus.*

Most of the naturally rearing mushrooms are poisonous; They exhibit attractive colours and contain terpenoid, 1, 4 – dialdehyde group which is very much essential to the biological activities like antibiotics, antifeedant activities, mutagenicity and cytotoxicity of the organisms [1]. But edible mushrooms are not at all attractive in colour. So experts can easily identify their colour, structure and smell etc. At the same time, most of the poisonous mushrooms have bowl like stem base; milk is secreted in the head part of the mushroom but it is absent in edible mushrooms. So artificially cultivated mushrooms are good for consuming purpose when compared with natural mushrooms.

In India with its diversity of soil and climatic conditions a rich variety of floras including edible mushrooms numbering about 2000 species occur. About 80 species are used to be taken by the local people especially by the tribals. Only some of them are considered to be commercially important and they have acquired a name in the international markets. In India, commercial cultivation is extended to three mushrooms namely button mushroom (*Agaricusbisporus*), Paddy straw mushroom (V*elvariellavolvacea*), and Oyster mushroom (*Pleurotusostreatus*,). Besides these, there are vast numbers of fungi which are also edible. The mushrooms are rich in protein. The proteins are comparable to muscle protein in nutritive value. Being a good source of vitamin, the protein is considered to have a distinct food value. It contains about nine essential aminoacids such as arginine, histidine, lysine, leucine, isoleucine, methionine, phenylalanine, threonine and valine[2].Common mushroom contains a higher proportion of water. On dry weight basis mushrooms are richer in protein than any comparable fruit or vegetable, containing rich source of vitamins including ascorbic acid, folic acid, niacin, pyridoxine, riboflavin, thiamine and α–tocophenol[3]. Mushrooms are considered all over the world ,as valuable health foods since they are poor in calories, fat and essential fattyacids and rich in proteins, vitamins and minerals.[4]

2. Materials and Methods

2.1. Chemicals

Anthrone is purchased from M/S. Hopkins and Williams (England) .Bovine serum albumin and dipyridyl were purchased from sigma chemicals (St.Louis, USA). Amino

naphtholsulphonic acid is purchased from sarabhai, M.chemicals, Baroda and all the other chemicals and reagents used were of analytical grade and were obtained from SD fine chemicals, Mumbai, India.

2.2. Description of the study area

This research was arrived at Taramani Campus, Institute of Basic Medical sciences, Chennai – 600 113, which is located in Taramani about a distance of 15km from Anna Nagar, Chennai (Capital City of Tamilnadu, South India)[5]. *Agaricusbisporus* and *Pleurotusostreatus* mushrooms were collected from the spawn producing centres, Ponds India Limited, Chennai.

2.3. Experimental Design

The oyster *(Pleurotusostreatus*) and button (*Agaricusbisporus*) mushrooms are selected for the study; as they can be reared easily and successfully in the existing climatic conditions and their importance as edible species they have wider distribution. But they differ only in their temperature requirement and duration of the growth. P.ostreatus grow in clusters at 18° to 38°c in 20 to 38 days, whereas A.bisporus grow in hill areas at a temperature of 12° to 14°c in just 19 days.

The pileus and stipes of the mushrooms were separated and analysed individually. (*Agaricusbisporus* Figs 1, 2 and 3.*Pleurotus ostreatus* ,Fig 4) About 1 kg of fresh mushroom when dried gives 60 gms to 80 gms of dry mushroom powder. Whole mushrooms were dried in the shade and then finely powdered [6].

2.4. Procedure

The moisture content of mushroom was determined by drying the wet cakes in an oven at 60° for 24 hours [7].The protein content was determined by the method of Lowry, et al., 1951[8]. A Known weight of the MR powder was heated with 30 percent potassium hydroxide in a boiling water-bath for 15 minutes and then centrifuged. The residue was washed three times with 30 percent potassium hydroxide and finally discarded the residue. The pooled supernatant fractions were made upto a definite volume and estimated the carbohydrate content by the method of Saffer, et al., 1950[9]. Nitrogen estimation was carried out by Micro kjeldahl digestion followed by Nesslerization by the method of Harrison, 1947,[10]as described by Varley, 1969[11] with slight modifications. Inorganic phosphorus was measured using the method of Fiske and Subbarow, 1925[12]. Two samples of mushroom were gathered from spawn producing centers. After cleaning and drying, the mushrooms were milled. The samples (200 mg mushroom powder) were digested in closed Teflon bombs [+2 cm^3 HNO_3 (65%) + 2 cm^3 H_2O_2 (30%)] at 1.56 x 10^5 pa pressure. The material was filtered and diluted. Then the A1, Ca, P, K, Na, Si and Ti content were determined by plasma generated spectroscopy.

Five grams of each of the oven dried and powdered samples were put into separate acid washed crucibles, covered and ashed in a muffle furnace at 420°c overnight to prevent loss of any of the minerals understudy Hansen, 1973[13] and allowed to cool. The incompletely ashed samples were then digested by the method described below. The inner surface of the cover was washed into the crucible with three 2.5 ml portions of concentrated nitric acid. The crucible was warmed until copious fumes of nitrous oxide were evolved. One 2.5 ml portion of concentrated nitric acid was added to the digestion mixture, followed by a 2.5 ml portion of concentrated sulfuric acid. The crucible was heated on an electric heater until copious brown fumes were evolved. Digestion of the samples was carried out in a fume chamber.

After cooling, the digest was poured into an acid – washed 100ml flask through a funnel plugged with glass wool. The crucible was washed into the flask with two 5 ml portions of concentrated sulfuric acid and subsequently with four 5 ml portions of distilled water. The funnel with the glass wool was finally washed down into the flask plate. Hydrogen peroxide (50%) was added drop-wise to the digest allowing the reaction. Addition of hydrogen peroxide was continued until the solution was colorless[14].The solution was made upto 100 ml with distillated water. To estimate the recovery of the test trace minerals, standard (working) solutions of the minerals were prepared according to Hansen, 1973[13]. Appropriate volumes of the standard (working) solutions were added to 5 g of each test sample to give a total of between 1 µg and 5 g and 10µg and 5 g depending on the concentrations of the minerals found in the samples. The spiked samples were dried to constant weight of 60°c before they were digested as described above. The digests of the spiked and unspiked samples were analyzed to trace out minerals using Pekin- Elmer (305B) atomic absorption spectrophotometer. Each experiment was done in duplicate. The following minerals like copper, iron, lead, manganese, magnesium, nickel and Zinc were analyzed using flame AAS technique.

2.5. Statistical Analysis

The distribution of the nutrient contents of individuals species, differences between pileus and stipes of both mushrooms like *Agaricusbisporus* and *Pleurotusostreatus* were assumed to be normal, and an arithmetic mean (AM) and standard deviations (SD) were calculated as representative parameters of the distribution. For statistical analysis, student test was used.

Figs 1,2and 3.AgaricusbisporusFig 4 .Pleurotusostreatus.

3. Results and Discussion

Table 1, indicates the data on fresh wet basis of pileus of the genera Agaricus and Pleurotus. The moisture contents of *Agaricusbisporus* are less than Pleurotus. The protein and ash content of fresh wet basis of pileus of Agaricus are comparatively higher than Pleurotus. Besides, the total lipid content are highly significant (P< 0.0001).

The data given in the tables(2), (3), (4) and (5) revealed that there is a significant difference in the nutrient contents on dry basis pileus and stipes and that the contents of protein, carbohydrate, lipid, ascorbic acid, and α-tocopherol. Therefore, the evaluation of nutrient composition includes the determination of proteins, carbohydrates and vitamins. The nutrient composition may be called as neutraceuticals if it provides medical or health benefits like the prevention and treatment of disease. The crude protein content of edible mushrooms is usually high. And the minerals like nitrogen, total and inorganic phosphorus, calcium, total iron, manganese, magnesium. Nickel and titanium were found to be higher in pileus than stipes, while sodium, alumina, silica and selenium were found to be higher in stipes than pileus.

But in *Agaricusbisporus*, the alumina and silica contents of the pileus were found to be higher than stipes while total iron, manganese and titanium were present only in traces[15].The carbohydrate content of edible mushrooms varies with species and ranges. The antioxidant activity and antioxidant compounds in seven wild mushrooms[16]were determined including α-tocopherol and β–carotene. Therefore, edible mushrooms are an ideal for the dietetic prevention of hyper glycemia, because of their high dietary fiber and protein and low fat content [17].

Table1: Nutrient contents of Edible Mushrooms on Fresh Wet Basis of Pileus(P) of *Agaricusbisporus* (Agb) and *Pleurotusostreatus* (Po)

Ingredients mg/100gm	Pileusgm/100gm of tissue			
	***Agaricusbisporus* (Agb)**	***Pleurotusostreatus* (Po)**	**t-value**	**p-value**
Moisture	87.77 ± 5.40	90.10 ± 1.23	1.03	0.326
Ash	0.85 ± 0.81	1.19 ± 0.67	0.78	0.451
Protein	3.14 ± 1.38	2.43 ± 0.49	1.19	0.263
Carbohydrate	3.23 ± 1.89	3.24 ± 1.01	0.01	0.993
Total lipid	0.17 ± 0.12	0.61 ± 0.08	7.58	0.000#

Values are expressed as gm/100gm of tissue and are mean ± SD for Six samples in each group. Statistically significant alterations are expressed as # p <0.0001.

Table 2: Nutrient contents of Edible Mushrooms on Dry Weight Basis of Pileus (P) of *Agaricusbisporus* (AgbP) and *Pleurotusostreatus* (PoP)

Nutrient contents gm/100gm	Agaricusbisporus (AgbP)	Pleurotusostreatus (PoP)	t-value	p-value
Protein	32.0 ± 5.46	28.98 ± 2.02	1.27	0.233
Carbohydrate	12.90 ± 0.42	11.20 ± 2.29	1.79	0.104
Total Lipid	6.60 ± 0.69	8.10 ± 0.95	3.13	0.011▣
Ascorbic Acid	0.08 ± 0.01	0.07 ± 0.04	0.58	0.576
α-tocopherol	0.04 ± 0.01	0.03 ± 0.01	1.58	0.145

Values are expressed as gm/100gm of tissue and are mean ± SD for Six samples in each group. Statistically significant alterations are expressed as ▣p<0.01.

Table 3 : Nutrient contents of Edible Mushrooms on Dry Weight Basis of Stipes(S) of *Agaricusbisporus* (Agb) and *PleurotusOstreatus* (Po)

Nutrient contents gm/100gm	Agaricusbisporus (AgbS)	Pleurotusostreatus (PoS)	t-value	p-value
Protein	12.99 ±0.97	11.20±0.89	3.33	0.008▣
Carbohydrate	10.21 ±1.42	9.80±2.45	0.35	0.731
Total Lipid	4.00 ±1.40	3.20±0.80	1.24	0.243
Ascorbic Acid	0.05 ±0.01	0.04±0.01	1.46	0.17
α-tocopherol	0.02 ±0.00	0.01±0.00	4.24	0.002▣

Values are expressed as gm/100gm of tissue and the mean ± SD for Six samples in each group. Statistically significant alterations are expressed as ▣ p <0.01.

Table 4 : Mineral contents of Edible Mushrooms on Dry Weight Basis of Pileus(P) of *Agaricusbisporus* (Agb) and *Pleurotusostreatus* (Po)

Ingredients mg/Kg	Agaricusbisporus (AgbP)	Pleurotusostreatus (PoP)
1. Selenium	0.496 ± 0.02	0.270 ± 0.02
2. Titanium	20.00 ± 9.84	50.00 ± 15.49
3. Nickel	30.75 ± 0.49	18.00 ± 1.41
4. Inorganic Phosphorus	400.00 ± 7.01	500.00 ± 9.25
5. Phosphorus	1300.00 ± 69.35	1200.61 ± 35.72
6. Nitrogen	80.00 ± 25.50	100.00 ± 60.66
7. Aluminium	10.333 ± 62.50	11.00 ± 32.86
8. Manganese	45.00 ± 74.03	73.00 ± 74.03
9. Iron	350.00 ± 58.31	270.00 ± 81.73
10. Sodium	19.00 ± 36.31	18.17 ± 84.10
11. Magnesium	100.00 ± 50.99	390.00 ± 60.81
12. Copper	698.50 ± 34.65	183.50 ± 13.44
13. Silicon	811.67 ± 125.29	290.00 ± 23.66
14. Zinc	81.60 ± 4.24	48.90 ± 4.95
15. Calcium	12.30 ± 46.90	9.92 ± 15.78

Proteins of pileus of *Agaricusbisporus* and *Pleurotusostreatus* were found to be significantly higher than stipes. Similar observations were made by Basundhara Devi and Shanthi Bala Devi, 1992[18] in clitocytemulticeps, mushroom proteins play an essential functional role in sausage manufacturing when they form stable emulsions. Presence of different amounts of proteins in pileusand stipes of oyster and button mushrooms have shown that these mushrooms are good source of proteins.

The Carbohydrate level was found to be very low when compared with the protein content of the mushrooms. Having very low carbohydrate content it may be considered as a suitable food source for diabetic patients [19].

The present analysis also revealed the presence of more fat in the pileus than stipes. Higher lipid content in the pileusmight have been due to the accumulation of fat globules in the spores present in the gills of pileus. It also helps to decrease the accumulation of cholesterol and triglycerides in the liver of Syrian hamsters [20].

Table 5 : Mineral contents of Edible Mushrooms on Dry Weight Basis of Stipes (S) of *Agaricusbisporus* (Agb) and *Pleurotusostreatus* (Po)

Ingredients mg/Kg	*Agaricusbisporus* (AgbS)	*Pleurotusostreatus* (PoS)
1. Selenium	0.565± 0.06	0.370 ± 0.03
2. Titanium	20.00 ± 9.84	40.00 ± 17.89
3. Nickel	21.00 ± 0.57	12.57 ± 0.49
4. Inorganic Phosphorus	230.33 ± 10.21	300.00 ± 24.58
5. Phosphorus	500.00 ± 18.28	330.33 ± 21.14
6. Nitrogen	60.00 ± 3.89	50.00 ± 16.73
7. Aluminium	10.00 ± 41.95	19.00 ± 46.48
8. Manganese	10.00 ± 50.99	26.00 ± 86.72
9. Iron	200.00 ± 27.57	150.00 ± 45.17
10. Sodium	20.00 ± 80.25	38.50 ± 55.09
11. Magnesium	230.00 ± 71.21	670.00 ± 121.16
12. Copper	637.00 ± 25.46	176.50 ± 24.75
13. Silicon	640.00 ± 70.14	770.00 ± 101.39
14. Zinc	89.80 ± 22.63	65.10 ± 16.26
15. Calcium	10.30 ± 36.93	11.70 ± 36.32

Pileuspart of these mushrooms are found to have higher percentage of ascorbic acid then stipes. Presence of ascorbic acid in some edible mushrooms has also been reported by Yokokawa, 1985[21].

High levels of protein, low level of fat and sufficient amount of ascorbic acid in the edible mushrooms including *Agaricusbisporus, Flammulinavelutipes, Lentinusedodus, Pleurotu-sostreatus* and *Volvariellavolvacea* have also been reported by Stijve, 1990[22].

According to the present analysis the relative amounts of α–tocopherol varied slightly in pileus than stipes, and also mushroom are good source of the vitamins, folic acid, niacin, pyridoxin and riboflavin[22].

The data given in Table (4) revealed that there is a significant different in the mineral contents of both species, and that the minerals like nitrogen, total and inorganic phosphorus silicon, calcium, magnesium, iron, phosphorus, manganese, titanium, copper and nickel were found to be higher in pileus than stipes while alumina, silica, sodium, potassium, magnesium, Zinc and selenium were found to be higher in stipes than pileus.

3.1. Nitrogen

Nitrogen compounds are very important components of human milk with respect to nutrition and defence of the new born infant [23].It also stimulates the release to prolactin from rat anterior pituitary cells in vitro. The results also indicate that the mushroom are good sources of nitrogen[24].

3.2. Calcium and Phosphorus

Calcium and Phosphorus were found to be higher in pileus of Agaricus than stipes, whereas the stipes of Pleurotus were found to be higher calcium than pileus of Pleurotus. Calcium play a fundamental role in controlling functions. Dietary calcium and phosphorus intakes is often considered to be a primary factor in bone mineralization and metabolism[25].Other studies also have shown a potential for increased calcium intake and calcium supplementation in the treatment of osteoporosis.

3.3. Copper

The copper binding peptide, purified and characterized from the mushroom Grifola Frondosa enhanced copper absorption in the intestinal lumen. This accumulation suggests a possibility that the peptide or its digestive products play an important role in the copper transport to liver as a copper transport to liver as a copper ligand [26].Copper is the third most abundant trace element in human body, with vitamin like impact on living systems. Small amount of coper is found in the human body (50 – 120 mg) but it plays a critical role in a variety of biochemical processes. The copper content of the pileus of *Agaricusbisporus* and *Pleurotusostreatus* are 698.50, 183.50 mg/kg, and the stipes of *Agaricusbisporus* and *Pleurotusostreatus* are

637.00 and 176.50 mg/kg. The stipe of *Pleurotusostreatus* had the lowest copper concentration whereas the pileus of *Agaricusbisporus* had the highest copper concentrations, accumulated in mushroom species are usually 100 – 300 mg/kg which is not considered a health risk [27].

3.4. Manganese

Manganese is an essential component of the mitochondrial oxidant scavenging enzyme, manganese super oxide dismutase. Dietary deficiency of this micronutrient results in decreased activity of the enzyme with an accompanying decreased resistance to lipid peroxidation in mitochondrial homogenates. Manganese deficiency has been shown to adversely affect glucose tolerance in mice, rats, guinea pig and chicks [28]. Magnesium is required in the regulation of glucose metabolism as well as in lipid metabolism. A deficiency of magnesium was shown to affect the humoral immune system. Manganese is present in metalloproteins, such as pyruvate carboxylase and in the cytoplasmic enzyme, glutamine synthetase. Manganese contents of mushroom samples were found in the pileus of *Agariousbisporus* and *Pleurotusostreatus* are 45.00, 73.00 mg / kg. Further the stipes of *Agaricusbisporus* and *Pleurotusostreatus* are 10.00 and 26.00 mg / kg. Toxicity limits of manganese for plants are high (400 – 1000 mg/kg). The values are under toxicity limits. Manganese concentrations of mushroom samples, in the literature, have been reported in the rangesof 14.5 – 63.6 mg / kg [29], 7.1 – 81.3 mg /kg [30] respectively. The values for these species are in agreement with those reported earlier.

3.5. Titanium

The titanium of *Agaricusbisporus* stipes and pileus are equal. Considering these facts, it is surprising to note that no reports on titanium content in fungi have been published.

3.6. Silicon

Silicon is essential for the production of connective tissue with specific involvement in the bio-synthesis of collagen. This subject has been reviewed by Carlisle, 1988[31]. The effectiveness of 540 mg silicon/ kg diet in promoting weight gain and the ineffectiveness of lower levels for this purpose, it is in accordance with the earlier findings Schwarz and Milne, that 500 mg, but not 250 mg silicon / Kg diet gave growth response in rats.

3.7. Zinc

Zinc is an integral component of a wide variety of different enzymes in which it plays catalytic, structural and regulatory roles. Many metal enzymes such as alkaline phosphatase of E.coli, horse liver alcohol dehydrogenase [32] and bovine lens aminopeptidase[33] have been reported to contain Zinc which plays a variety of roles in the enzymes. Zinc has been reported to be essential for growth and development of all living, matter with all classes of polymerases from prokaryotes, enkaryotes and viruses being zinc – metaloenzymes[33].

Vallee, 1981,[33]reported that Zinc was indispensable for DNA, RNA and protein synthesis. Since these mushrooms are rich in zinc, their regular incorporation in the human diet will go a long way to overcome the retardation of growth and sexual maturity which has been linked with zinc deficiency [32].

Zinc deficiency which can result from inadequate dietary intake, impaired absorption, excessive excretion or inherited defects in Zinc metabolism. The deficiency of zinc particularly in children can lead to loss of appetite, growth retardation, weakness, low spirited, stagnation in sexual growth. Minimum and maximum values of Zinc in the samples were 81.6 and 48.9 mg /kg in pileus of Agb and Po. The WHO permissible limit of Zinc in food is 60 mg/kg [34]. Zinc concentration of mushroom samples in the literature have been reported to be in the ranges 29.3 – 158 mg / kg [29], 33.5 – 89.5 mg /kg [35] respectively. The zinc values are in agreement with literature value.

3.8. Nickel

Trace amounts of nickel may be beneficial as an activator of some enzyme systems, but its toxicity at higher levels is more prominent. It accumulates in the lungs and may cause bronchial hemorrhage or collapse [36].Maximum nickel level was 30.75 and 18.00 mg/kg in pileus of *Agaricusbisporus* and *Pleurotusostreatus* and also 21.00, 12.57 mg/kg in stipes of *Agaricusbisporus* and *Pleurotusostreatus*. The WHO recommended daily intake of nickel was between 100 and 300 mg/kg [37]. Nickel values have been reported in the ranges 8.2 – 21.6 mg/kg [38] and 1.22 – 58.60 mg / Kg [39] respectively. The nickel values are in agreement with those reported in the literature.

3.9. Selenium

According to Vetter, 1993, the synthesis of ubiquinone (CoenzymeQ) is dependent on selenium and this element plays a role in the respiration chain and in the conversion of NAD – NADH. Certain selenium compounds have

anticarcinogen effect. *Agaricusbisporu*s contains much more selenium than fruits and vegetables, Mushrooms contain a high percentage of protein, it is expected that they are able to incorporate high percentage of selenium into aminoacids such as selenocistein and selenomethionine. The content of selenium in mushrooms mostly ranges between 0.57 and 19.46 mg /kg depending on the type, age and place of finding mushroom [40]. Low percent of selenium in foods is related to the endemic occurrence of cardiovascular diseases and disorders of bone and joint system, metabolic disorders and malignancies of the thyroid glands. Glutathione peroxidase containing selenium performs decomposition of hydrogen peroxide and lipid hydroperoxides in tissues and tissue fluids and together with vitamin E protects cell membranes and other structures of peroxides, thereby inhibiting lipid peroxidation in tissues [41]. The level of selenium content in *Agaricusbisporus* is 1.1 mg / kg and Pleurotusostr-eatus is 0.64 mg/kg. The selenium contents of these mushrooms are sufficient to provide nutritionally significant amounts in relation to the total daily intake of selenium.

3.10. Sodium

Due to high potassium and low sodium content, they are ideal food for people having blood pressure [42].

3.11. Iron

Iron is vital for almost all living organisms, participating in a wide variety of metabolic processes, including oxygen transport, DNA synthesis and electron transport. It is known as adequate iron in a diet is very important for decreasing the incidence of anemia. Iron deficiency occurs when the demand for iron is high, e.g. in growth, high menstrual loss and pregnancy and the intake is quantitatively inadequate or contains elements that render the iron unavailable for absorption.. High Concentrations of iron may lead to tissue damage, as a result of the formation of free radicals. Nutritional iron deficiency results in defect in thermo regulatory capacity in cold stressed human as well as in models. Iron deficiency also results in altered thyroid hormone metabolism throughout the estrous cycle. The highest iron content in the mushroom samples was 350 mg / kg in pileus of *Agaricusbisporus*, whereas the lowest iron content was 150 mg / kg in stipes of *Pleurotusostreatus*. The reported iron values for mushroom samples were 30 -150 mg / kg[43], 180 – 470 mg/kg[29]. The iron values are similar to those of previous studies.

3.12. Magnesium

Magnesium helps to maintain normal muscle and nerve function, keeps heart rhythm steady, supports a healthy immune system and keeps bone strong. One kg of *Agaricusbisporus* contains 430mg of magnesium and *Pleurotusostreatus* contain 1.06 g of magnesium.

3.13. Aluminum

Aluminium is non- essential metal as they are toxic even in trace[44]. Thealuminum content of *Agaricusbisporus* and *Pleurotusostreatus* is very less content. So no toxic effect is reported

So far, no pertinent information is available concerning the occurrence of appreciable quantities of other toxic trace elements in cultivated and wild mushrooms. However, toxicity by the presence of the minerals in these mushrooms has never been reported by consumers. Though there are differences in the nutrient contents of pileus and stipes the whole mushroom is found to show high nutritional value.

Therefore, the accumulation of heavy metals in macro fungi has been found to be affected by environmental and fungal factors. Environmental factors, such as organic matter amount, PH and metal concentration in soil, and fungal factors, such as species of mushroom, morphological part of fruiting body, development stages, age of mycelium and biochemical composition, affect metal accumulation in macro fungi [44].

4. Conclusion

Being very tasty and rich in nutrients the mushrooms are known for their low calorie content and fat.. The consumption of mushrooms has important benefits for human body. Thus, placed in the daily diet, the mushrooms can prevent the emergence of serious diseases such as breast cancer, anaemia, chronic fatigue, asthenia or various diseases caused by the weakening of the immune system and also help to strengthen the immune system and increase the male potency. Three to four weekly servings of mushrooms are a perfect sources of protein. Mushrooms also have role in tissue regenation, and all parts of the nervous system, ensure proper functioning of glands (thyroid) and also contributes to the formation of antibodies and normal functioning of skin etc. The content of nutrients in mushrooms is remarkable 30-40 percent of their dry weight are proteins (meat has 15-25 percent) . Mushrooms also contain almost all mineral elements necessary for human body, and vitamins A, B1, B2, D (Data not given). Therefore, the main features are

organic and cerebral stimulation and remineralisation of the body.

The mushrooms can prevent and treat anxiety, fatigue and stress, due to the high Zinc content and vitamins from group B (data not furnished). The daily consumption of three mushrooms significantly reduces the sensation of physical and mental exhaustion, but also unpleasant feeling of irritation and anxiety. Used for centuries in medicine, mushrooms have powerful effects on the immune system. They prevent and treat cancer, viral infections, high cholesterol and hypertension. In Asia, mushrooms are used as an adjuvant in cancer treatment, due to its ability to counteract the toxic effects of chemotherapy and radiation. It was confirmed by the laboratories that the mushrooms have an inhibiting activity against the poliovirus. Also, mushrooms are rich in antioxidants, essential in preventing serious illnesses like cancer or diseases of old age. Therefore, the mushrooms may be used directly in the diet to promote health, taking advantage of the additive and synergistic effects of the bioactive compounds present in them. The potential therapeutic implications of mushrooms are enormous but detailed mechanisms of the various health benefits of mushrooms to humans still require intensive investigation, especially with the emergence of new evidence of their health benefit effects. The exploration of newly cultivated mushrooms and isolation of their active ingredients with mechanism based potential therapeutic value remains a challenge and hence mushrooms will keep the foremost spot light of research in the upcoming prospect as well and also the present study emphasized the need of edible mushrooms selected to be grown on a large scale since this industry is providing self-employment.

5. Acknowledgement

The financial support for the Senior Research Fellowship extended by the Indian Council of Medical Research, New Delhi is gratefully acknowledged. The authors are also thankful to Mr.G.Kolandaivelu (Retd.Asst, Director of Economics & Statistics) for the help in finalizing analysis of the statistical work and in this regard his valuable help is dully acknowledged.

6. References

1. P.Morales,M.Anderson ,L.Lewan and O. sterner . Mutation Research. **(1992)**, 268, 315-321.
2. S.Kannaiyan and K. Ramasamy . A Hand Book of Edible Mushrooms.**(1980)**, 40.
3. W.Lasotaand.D. Florezak. Bromatolchem Toksykol.**(1983)**, 16,177.
4. F.S.Reis,L.Barros,A.MartinsandFerreira.FoodChem.Toxicol .**(2012)**,50,191-197.
5. G.K.Poongkodi and D. Sakthisekaran. J.of science and sustainable development (JSSD). **(2014)**2(2),48-63.
6. G.K.Poongkodi, G.P.HarshithaPriya and G.P.Harithra Priya. International Journal of Modern Chemistry and Applied Science. **(2015)**,2(1),44-49.
7. Usha, Goet, L.Bansi,Kawatra and Satinder Bajaj.. J. Sci. Fd. Agric. **(1977)**, 28. 786 – 790.
8. O.H..Lowry,N.J.Rosebrough,A.L.Farr and R.J.Randall. J.Biol Chem.**(1951)**,193, 265-275.
9. S.Saffer ,S. Dayton ,C.B. Novi and E. Muntwyler.Arch. Biochem.**(1950)**, 25, 191.
10. G.A..Harrison .Chemical methods in clinical medicine. **(1947)**, (Churchill livingstone), 319.
11. H.Varley. In practical clinical bio-chemistry.**(1969)**,158.
12. C.H.Fiske and Y. Subbarow. J. Biol, chem.**(1925),**56, 375 – 400.
13. N.W.Hansen .Standard and recommended methods for analysis.**(1973)**, 17, 53-56, 260-270-271.
14. H.K.HundleyandE.C.Warren . A.O.A.C. **(1970)**, 53; 705 -709.
15. T.Longvah and Y.G. Deosthale. Food Chem. **(1998)**, 63: 331 – 334.
16. K.M.Lo,P.C.K.Cheung.FoodChem.**(2005)**, 89, :533 – 539.
17. F.J..AlarconAguilara,R.Roman Ramos, S,Perez Gutierrez and A.Aguilara Contreras.. J. Ethnopharmacol. **(1998)**,61: 101 – 110.
18. T.H..Basundhara Devi and G.A.Shanthi Bala Devi. Nutrients in wild mushrooms clitocybemulticeps (peek). **(1992)**, 29(3): 189 – 190.
19. K.Kubo and H.Namba. In: Mushroom biology and mushroom products. **(1996)**, 215 – 221.
20. P.Bobek ,E. Ginter , LubomirKuniak, J.Babala ,M.Jurcovicova, L. Ozdin, and J.Cerven. J.Nutr,**(1991)**,7:105-108.
21. H.Yokokawa.TachikawaTandaikiya.**(1985)**, 18, 45.
22. T.Stijve.Technical management communi-cations,**(1990)**, 31 – 35.

23. S.Patton andG.E.Huston.Nut. Rep. Intern. **(1984)**, 30, 140.
24. J.P.Baars. Nitrogen metabolism in the commercial mushroom Agaricusbisporus. **(1996)**, 32- 38.
25. J.Vetter .ActaAlimentaria, **(1994)**,23(3): 331 – 336.
26. IwaoShimaoka, Junko Kodama, K.NishinoandY. Itokawa . J. Nutr. Biochem. **(1993)**, 1, 33 – 38.
27. M.Soylak,S.Saracoglu,M.Tuzen and D.Mendil. Food Chemistry, **(2005)**, 92, 64-652.
28. S..ZidenbergCherr,C.L. Keen ,B. Lonnerdal and L.S. Hurley. J. Nutr. **(1983)**, 113, 2498 – 2504.
29. M.IsioloGlu,F.Yilmaz and M.Merdivan .Food chemistry.**(2001)**, 73, 169 – 175.
30. O.Isildak,I.Turkekul,M. Elmastas and M.Tuzen .Food Chemistry. **(2004)**,86. 547 – 552.
31. E.M..Carlisle. Sci. Total Environ.**(1988)**, 73, 95 – 106.
32. A.Victoria . J of food composition and analysis.**(1991)**,4. 167 – 174.
33. B.Vallee .In structural and functional aspects of enzyme catalysis.**(1981)**,75 – 95.
34. World Health Organisation, (Twenty – Sixth Report of the Joint FAO / WHO Expert committee on Food Additives). **(1982)**.
35. M.Tuzen,I.Turkekul,E.Hasdemir,D.Mendil and H.Sari.Turkey Analytical Letters. **(2003)**, 36, 1401 – 1410.
36. S.A.Demirba. Food chemistry.**(2001)** , 74, 293 – 301.
37. World health organization, 2nd edn. Geneva. WHO.**(1994).**
38. D.Mendil, O.D.Uluozhu, E.Hasdemir and A.Caglar. Turkey. Food Chemistry, **(2004)**. 88, 281 – 285.
39. M.Yamac D. Yildiz and C.Sarikurkcuc. Turkey Food chemistry,**(2007)**, 103, 263 – 267.
40. M.Savic. Maticasrpska processings for natural sciences. **(2009)**, 116: 7 – 14.
41. J.Gromadzinska . Eur. J. Nutr. **(2008)**, 47, (Suppl. 2): 29 – 50.
42. G.S.Mansukhani. Unique quintessence of Advance General studies for UPSC Civil Services main examination. 11th Edition, Lajpat Nagar, New Delhi 6. **(1992)**, 150.
43. C.P.Kala and L. Svoboda. Food chemistry, **(2001)**, 69, 273 – 281.
44. Fangkunzhu, LiQu, Wenziu Fan, MeiyingQigo,and Hailing Hao. Springer Science, Business Media. **(2010)**, B.V.