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Rohit Lall
Department of Molecular and Cellular Engineering, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad U.P, India

Poonam singh
Department of Molecular and Cellular Engineering, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad U.P, India

Kirti Singh
Department of Molecular and Cellular Engineering, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad U.P, India

Anupam Jha
Department of Molecular and Cellular Engineering, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad U.P, India

Vartika Gupta
Department of Molecular and Cellular Engineering, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad U.P, India

Shraddha Nagar
Department of Molecular and Cellular Engineering, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad U.P, India

Correspondence
Rohit Lall
Department of Molecular and Cellular Engineering, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad U.P, India

Comparative study of nutritional, antimicrobial and antioxidant properties of *Pleurotus ostreatus* and *Agaricus bisporus*

Rohit Lall, Poonam singh, Kirti Singh, Anupam Jha, Vartika Gupta and Shraddha Nagar

Abstract
The phytochemical analysis of two very common commercially grown varieties of mushrooms i.e.,: *Pleurotus ostreatus & Agaricus bisporus* was donein the present study. Antimicrobial property of mushroom extract was studied for various gram positive and gram negative bacteria (*E. coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Staphylococcus aureus)*. The extracts show antimicrobial property against all tested bacterial strains and it reveals that mushroom was rich with antioxidants. The presence of alkaloids, carbohydrates, flavanoids, amino acids, vitamins (ascorbic acid) and phenolic compounds has been identified quantitatively these compounds are estmitated by spectrophotometer. Phytochemical investigation indicated the presence of high concentration of carbohydrates, amino acids, vitamin c, phenols, flavanoids, alkaloids in case of oyster mushroom while high concentration of protein and tannin was found in button mushroom. The reducing power assay indicated that Agaricus bisporush has high antioxidant potency with 0.3mg/ml concentration with highest absorbance. This study supports that mushroom can be used as a very nutritive source for various primary and secondary metabolites and can also be used as treatment of antibacterial disease.

Keywords: *Pleurotus ostreatus*, *Agaricus bisporus*, spectrophotometer, anti microbial activity, anti oxidants

Introduction
The two most extensively used varieties of mushroom are *Agaricus bisporus* (Button mushroom) and *Pleurotus ostreatus* (Oyster Mushroom). Are a wide variety of phytochemicals (Parihar *et al*., 2016) [16]. The Button Mushroom, is the most important commercially cultivated mushroom all over the world. Research findings demonstrate that the button mushroom possesses bioactive components of nutritional importance (Rezaeian and Pourianfar 2015) [21]. Agaricus bisporous (white button mushroom) is a reported to have antimicrobial property against various pathogenic bacteria which causes lethal diseases whereas oyster mushroom comprises of various primary and secondary metabolites (alkaloids, tannins, flavanoids, phenols) in a very good amount (Han *et al*., 2015) [8]. Mushroom also comprises of various anti microbial, anti fungal, anti viral, anti tumour and anti oxidant compounds effective against potent diseases (Dharmaraj *et al*., 2014) [6]. AST is used to determine sensitivity of antibiotic compounds against various pathogens (Iwalokun *et al*., 2007) [10]. Since synthetic antioxidants are sometimes toxic in nature, therefore a necessity of strong natural antioxidant (Muthangya *et al*., 2014) [14].
In the current study will examine the nutritional value of the two commercially used mushroom species namely, *Agaricus bisporus* and *Pleurotus ostreatus.* The primary metabolites and secondary metabolites are to be analyzed quantitatively and quantitatively. Further the antimicrobial properties of mushroom will be verified.

Materials and Methods
Collection of Mushroom
Fresh mushroom varieties Pleurotus *ostreatus* (oyster mushroom) were collected from organic farm of SHIATS, Allahabad, India and collection of *Agaricus bisporus* (white button mushroom*)* from market of Allahabad.

Preparation of Mushrooms Powder
Mushrooms were initially cleaned, then sliced into small pieces. They were dried in hot air oven at 45 °C for 2 hr and grinded in mixer-grinder to make fine powder. They were stored.

Preparation of Hot Water Extract
10 gm of both mushroom powder dissolved in 100ml of distilled water. The solutions were kept in water bath at 80°C for 3 hrs and filtered by Whatman filter paper NO. 4. The filtrate was stored in vials for further tests.

Qualitative Assessment of Mushroom
The Qualitative Assessment of Mushroom was performed as per the methods given by Harborne (1998) with slight modifications Adebayo *et al*. (2012) [1]; Parihar *et al*. (2015) [16]; Ramanathan *et al*. (2013) [20].

Quantitative Determination of Primary and Secondary Metabolites

Test for Carbohydrates
Total soluble carbohydrate content was determined by according to phenol sulphuric acid method by Devi *et al.,* (2015) [5]; Dharmaraj *et al.* (2014) [6].

Test for Protein
The total protein content was determine by the method of Lowry and Bradford by Dharmaraj *et al.*, (2014) [6].

Test For Free Amino Acids
The total amino acid concentration was determined by Ninhydrin method given by Devi and Krishnakumari. (2015 [5]; Dharmaraj *et al*. (2014) [6].

Test for Vitamin C
The total vitamin C content was measured by determined by using 2, 6- dichloroindophenol method by Chowdhury *et al.,* (2015) [3]; (Muthangya *et al*. (2014) [14]

Test for Phenols
The total phenol content was determine by Folin- Denis method by Devi and Krishnakumari. (2015) [5]; Chirinang and Intarapichet (2009) [2]; Iwalokun *et al.,* (2007) [10].

Test for Tannin
The total tannin content was determine by vanillin hydrochloride method by Devi and Krishnakumari. (2015) [5].

Test for Flavonoids
The total flavonoids content was determine by Aluminum Chloride method by Patel *et al*. (2010) [17]; Muthangya *et al*. (2014) [14]; Chowdhury *et al.,* (2015) [3].

Test for Alkaloid
The total alkaloid content was determine by BCG method by Devanaboyina *et al*., (2013) [4].

Antimicrobial Assay

Source of Microbes
Bacteria species were collected from Culture bank of Department of Microbiology and Fermentation Technology (MBFT) JSBB, SHIATS, Allahabad.

Antibiotic Sensitivity Test
The AST was performed by disc diffusion method in Nutrient Agar medium, according to procedure Kirby and Bauer Han *et al*. (2015); Owaid *et al*. (2015) [15, 8]; Tambekar *et al.* (2006) [23].

Minimum Inhibitory Concentration Test
MIC was done by the method of Moglad and Saadabi, (2012) [10]; Iwalokun (2007) [13]; Sharma *et al.* (2014) [22].

Reducing Power Assay
Ferric Reducing Antioxidant Power Assay Ferreira *et al*. (2005) [7]; Kosanic *et al*. (2013) [11]; Kozarski *et al*. (2013) [12].

Results and Discussion
In present investigation primary and secondary metabolites were qualitatively and quantitatively analyzed using *Pleurotus ostreatus & Agaricus bisporus* hot water extract. The result of varoius test performed are discussed in table 1, 2 and 3:

Table 1: Qualitative Asssement of Primary and Secondary Metabolites.

Primary and Secondary Metabolites	Test	Observation (Button and oyster)
Carbohydrates	Molish	Violet Ring
	Bendict	Dark Green
Protein	Millon	White ppt.
	Biuret	Pink Colour
Amino Acid	Ninhydrin	Purple Colour
Phenol and Tannin	Ferric Chloride	Dark Green Colour
	Lead Acetate	Bulky White ppt.
Flavonoid	Shinoda	Crimson Red
	Alkaline Reagent	Colourless
Alkaloids	Mayer's	Creamy White ppt.
	Dragendro-ff	Yellowish White ppt.
Minerals	Iron	Blue ppt
	Calcium	White ppt
	Phosphorous	Yellow ppt

Table 2: Quantitative estimation of Primary metabolites

Primary Metabolites	Button Mushroom	Oyster Mushroom
Carbohydrates	0.115±0.069	0.387±0.125
Proteins		
A)Lowry Method	0.098±0.076	0.021±0.118
B)Bradford Method	0.076±0.118	0.017±0.076
Amino Acid	0.063±0.141	0.083±0.064
Vitamin C	0.024±0.054	0.026±0.053

Values are expressed by mean± SD of samples

Table 3: Quantitative estimation of Secondary metabolites

Secondary Metabolites	Button Mushroom	Oyster Mushroom
Phenol	0.070±0.066	0.029±0.026
Flavonoid	0.137±0.005	0.318±0.034
Tannin	0.063±0.015	0.052±0.010
Alkaloid	0.205±0.031	0.244±0.113

Values are expressed by mean± SD of samples

The quantitative analysis of primary and secondary meabolites showed that high concentration of carbohydrate, amino acids, vitamin c, flavanoids and alkaloids were found in oyster mushroom while high concentraton of tannins, phenols and proteins were high in button muhroom. The increase in concentration of phenol level will increase the antioxidant potential of mushrooms. To determine the antimicrobial property of the two varieties of mushroom namely *P.ostreatus* and *A.bisporus.* In the case of *A.bisporus*, maximum zone of inhibition was observed in *E.coli*, *B.subtilis* and *S. aureus* having diameter 19mm, 20mm and 20mm respectively against standard antibiotics Ciprofloxacin and Ampicillin as shown in table 4. In case of *P.ostreatus*, maximum zone of inhibition was observed in *P. aureginosa* having diameter 19mm against against standard antibiotics Ciprofloxacin and Ampicillin as shown in table 4.

Table 4: Findings of Antibiotic sensitivity test.

Bacteria (ZOI) Antibiotic	E.coli	B. subtilis	P. aureginosa	S. aureus
Ampicillin	15mm	22mm	23mm	24mm
Ciprofloxacin	27mm	30mm	30mm	32mm
Button mushroom (Extract)	19mm	20mm	12mm	20mm
Oyster mushroom (Extract)	12mm	15mm	19mm	17mm

To know the antimicrobial potency of both the mushroom the MIC test was performed. In case of *B.subtilis*, minimum inhibitory concentration was found to be in *A.bisporus* at conc. 0.16mg/ml. In case of *P.aeruginosa*, minimum inhibitory concentration was found to be in *P.ostreatus* at conc. 0.16mg/ml. In case of *E.coli*, minimum inhibitory concentration was found to be in *A.bisporus* at conc. 0.8mg/ml against the antibiotic stock. In case of *S. aureus*, minimum inhibitory concentration was found to be in *P.ostreatus* at conc. 0.16mg/ml.

The values of antioxidant concentration are shown below:-

Antioxidant (Reducing Power Assay)- (Mean±Sd)

Oyster(0.2mg/Ml)- 0.198±0.0065

Button(0.2mg/Ml)- 0.183±0.0362

Oyster(0.3mg/Ml)-0.279 ±0.0556

Button(0.3mg/Ml)- 0.284±0.039

The high antioxidant acivity was reported in butoon mushroom while lower in oyster mushroom.The higher the concentration of extract showed increase in antioxidant level.

Conclusion

Thus the present study indicates that oyster mushroom has more nutritional benefits including carbohydrates, amino acids, vitamin c, flavonoids and alkaloids, whereas button mushroom has high proteins, phenols and tannins as well as strong antioxidant and antimicrobial activity indicating the presence of high phenol and tannin content respectively. The antioxidant property of mushroom by FRAP proved button mushroom has high reducing capacity as compared to oyster. Thus, we can conclude that both mushrooms have abundant nutritional and therapeutically properties.

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