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Short Communication

Antimicrobial Activity of Mushrooms against Skin Infection Causing Pathogens

M. Padmavathy, R.Sumathy*, N.Manikandan and R.Kumuthakalavalli

Department of Biology, The Gandhigram Rural Institute – Deemed University, Gandhigram, Dindigul
*Corresponding author email: sumathysaravanan.31@gmail.com

Mushrooms are nutritionally functional food and a source of physiologically beneficial and nontoxic medicines for various diseased conditions. In the present study antimicrobial properties of crude extracts of three commercial edible mushrooms (*Agaricus bisporus (J.E.Lange)* Imbach , *Pleurotus florida* (Mont.) and *Calocybe indica* (P&A) were tested against bacteria and fungi that cause local dermatitis by disc diffusion method. Highest anti-microbial activity was obtained from petroleum ether extract of *Agaricus bisporus*, with the zone of inhibition 17mm (*Streptococus pyogenes*), 15mm (*Staphylococus aureus*), 14mm (*Pseudomonas aeuroginosa*) and 13mm (*Candida albicans*) from 100µg/ml concentration of mushroom extracts respectively, while minimal zone was obtained from the petroleum ether extract of *Pleurotus florida* and very least inhibition was observed in *Calocybe indica*. From the results it is inferred that crude extracts of commercially available mushrooms namely *Agaricus bisporus* and *Pleurotus florida* can be used to treat pathogenic microbes that cause skin irritations, bristles and acnes. This study gives scope for the investigations on active constituents of mushrooms for better understanding of the healing mechanism.

Key word: skin infections, pathogens, *Agaricus bisporus, Pleurotus florida, Calocybe indica,*

Skin, hair, nail, and subcutaneous tissues in human are subjected to infection of bacteria and fungi that cause dermatitis, acne and skin irritations. These diseases are widely prevalent all over the world in various degrees and are treated with antibiotics. The number of multi-drug resistant microbial strains and the appearance of strains with reduced susceptibility to antibiotics are continuously increasing. Therefore, there is need to search for new infection-fighting strategies to control microbial infections (Sieradzki et al., 1999). Natural products most likely continue to exist and grow to become even more valuable as sources of new drug leads as they have a broader degree of chemical diversity and novelty of molecules found in natural products (Sai devi et al., 2012). There is a renewed interest in traditional medicine and an increasing demand for more drugs from plant sources. This revival of interest in plant-derived drugs is mainly due to the current widespread belief that "green medicine" is safe and more dependable than the costly synthetic drugs, many of which have adverse side effects (Nair and Chanda, 2007). This situation provided the impetus to the search for new antimicrobial substances from various sources like medicinal plants

and fungi including mushrooms (Cordell, 2000).

Mushrooms are being used nutritionally functional food as well as source of physiologically beneficial medicine. The use of mushrooms as a source for relief from illness can be traced back over five millennia to written documents of the early civilization in China, Korea and North East, but it is doubtless an art as old as mankind. Mushrooms represent a rich source of antimicrobial agents. The potential of mushrooms as source for new drugs is still largely unexplored. Among the estimated 140,000 mushroom species, only small percentages have been investigated for their therapeutic property and only very few are submitted to biological or pharmacological screening (Wasser, 2002). In recent years, a number of studies have been conducted in various countries to prove such efficiency. Many mushrooms have been used because of their antimicrobial traits, due to their secondary metabolites. These products are known by their active substances like, phenolic compounds which are part of the essential oils. Research has shown that some mushrooms exhibit *in vitro* anti-viral, anti-bacterial, and anti-fungal properties (Sorimachi et al., 2001).

In the present investigation edible mushrooms viz, *Pleurotus florida, Calocybe indica* and *Agaricus bisporus* were tested for their remedial activity against microbial pathogens that cause various skin infections.

Materials and Methods

Collection and Extraction of Mushroom fruit bodies

Fresh fruit bodies of *Pleurotus florida, Calocybe indica* and *Agaricus bisporus* were collected from mushroom retail shops and farms near Chinnalapatti, Dindigul, Tamil Nadu. The fruit bodies were washed thoroughly 2-3 times with running water and finally with sterile distilled water. Water was removed by blotting the mushrooms with tissue paper and then they were dried in shade, and blended to form a fine powder and stored in airtight containers in refrigerator at 4°C for future use. Before extraction the stored mushroom powder was kept in oven at 55°C for 1hr to remove moisture.

10g of fine powder of each mushroom was taken separately in 100 ml of petroleum ether in a soxhlet apparatus and extracted for 8 hrs at 40ºC. The aqueous solutions were then filtered using Whatman filter paper (No 1), concentrated in vaccum for 15 min at 37°C using a rotary evaporator. The concentrate was then dissolved in 5 ml of dimethyl - sulfoxide (DMSO) and stored at 4°C for further study (Nuran and Olcay, 2012).

Test Organism

Three bacteria (*Pseudomonas auueroginosa, Staphylococcus aureus* and *Streptococcus pyogenes)* and one yeast (*Candida albicans*) were used as pathogenic organisms in this study. Microorganisms were procured from MTCC, Chandigarh. The bacteria were maintained on nutrient broth (NB) at 37°C and fungus was maintained on Potato dextrose agar (PDA) at 28°C.Fresh 24hr old culture of bacteria and 5-8 day old culture of fungi were used as an inoculum.

Antibacterial Activity

The antibacterial activity was tested by the disc diffusion method (Anonymous, 1996) 100µg concentration of three mushroom samples dissolved in DMSO were used for preparing sterile discs. 10µl (10 cells/ml) of 24h culture of bacteria grown in nutrient broth were seeded into Muller –Hinton Agar medium by spread plate method. After solidification the filter paper discs (5 mm in diameter) impregnated with the extracts were placed on test organism seeded plates. Streptomycin sulphate (10 µg ml) used as positive control and DMSO (100 µg /ml) was used as negative control. The antibacterial assay plates were incubated at 37°C for 24h.

The diameters of the inhibition zones were measured in mm.

Antifungal activity

The antifungal activity was tested by disc diffusion method (Taylor et al., 1995). The potato dextrose agar plate was inoculated with fungal culture (5-8 days old) by point inoculation. The filter paper discs (5 mm diameter) impregnated with 100 µg/ ml concentrations of the extracts were placed on test organism-seeded plates. Blank disc impregnated with DMSO was used as negative control and Nystatin (10 µg/ disc) was used as positive control. The activity was determined after 72 h incubation at 28°C. The diameters of the inhibition zones were measured in mm.

Results and Discussion

In this study three edible mushrooms were evaluated for their anti-pathogenic potential against four microorganisms using disc diffusion assay (Fig-1). The petroleum ether extracts of *P. florida, A. bisporus* and *C. indica* were found to be active against tested bacteria as well as fungal pathogens. When tested by the disc diffusion method, the petroleum ether extracts of A*garicus bisporus* showed significant inhibitory activity followed by *Pleurotus florida* and *Calocybe indica*. Among the pathogens tested *Staphylococcus aureus* showed highest susceptibility to all the three mushroom extracts followed by *Streptococcus pyogenes*, *Pseudomonas aeuroginosa* and *Candida albicans*. Compared to the other two mushrooms *Calocybe indica* showed significantly least antimicrobial activity ranging from 07-10mm.

Mushrooms are important and potential source for the development of new chemotherapeutic agents and the first step towards this goal is the *in vitro* antimicrobial activity assay (Tona et al., 1998). Chang and Miles (1997) reported the antiviral, antibacterial, antifungal, anthelmintic, antimolluscal and anti-inflammatory properties of many mushrooms viz., *Lentinus edodes, Schizophyllum commune, Agaricus bisporus*. Chellal and Lukasova (1995) also stated the antibacterial activity of *Agaricus bisporus* against *B. subtilis* (12 mm), *S. aureus* (18-22 mm), *K. pneumonia* (15 mm), *P. aeruginosa* (12-16 mm) and *C. albicans* (12-14 mm).

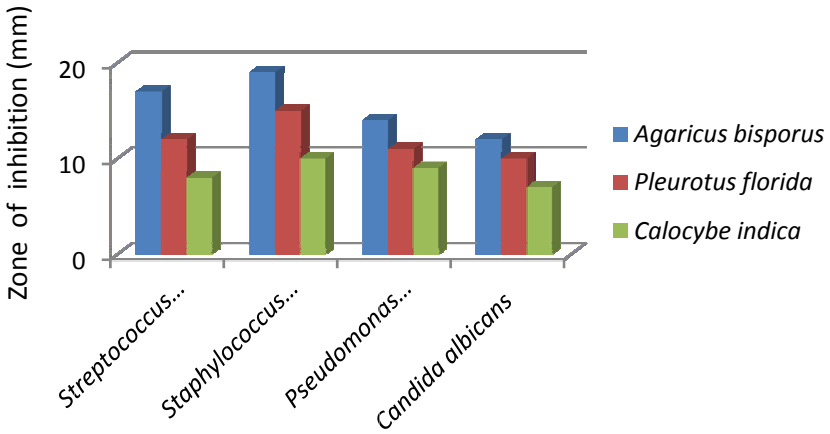

Figure 1. – Efficacy of mushrooms against skin infection causing pathogens

Reports of Jagadish et al (2009) revealed that the aqueous extract of *Pleurotus florida* and *Pleurotus aureovillosus* showed activity (16.0 - 20.0 mm) against *P. aeruginosa*,

S.aureus and *C. albicans*. This was in accordance with the present results. The antimicrobial activity of *Pleurotus eryngii* and *Agrocybe sp.* varieties showed activity against *B. megaterium*, *K. pneumoniae S. aureus* and *C.albicans* (Uzun et al., 2004). The broad spectrum of antimicrobial activity may be attributed to the presence of bioactive metabolites of various chemical types in mushrooms compounds. The antibacterial of the mushrooms might be due to their phytochemicals. Govindarajan et al (2006) also stated that mushroom species possess different constituents in different concentration, which account for their differential antimicrobial effect.

Selected pathogens cause a variety of suppurative infections in humans like superficial skin lesions and irritations and when untreated, will lead to more serious infections such as pneumonia, meningitis, urinary tract infections, food poisoning by releasing enterotoxins into food and toxic shock syndrome by release of super antigens into the blood stream (Lodhia et al., 2009). Results of the *in vitro* study revealed that the petroleum ether extract of mushrooms viz, *P.florida, A.bisporus* and *C.indica* exhibited significant inhibitory activity against pathogenic bacteria and fungi causing skin infection.

References

Anonymous. (1996). Pharmacopiea of India (The Indian Pharmacopiea), 3 Edn., Ministry of Health and Family Welfare, Govt. of India, New Delhi,

Chang ST and Miles PG. (1997). Mushroom Biology. World Scientific Publishing Co.Pte.Ltd., Singapore.

Chellal A and Lukasova E . (1995). Evidence for antibiotics in the two Algerien Truffles Terfezia and Tirmania. *Pharmazie*. 50: 228-229.

Cordell GA. (2000). Biodiversity and drug discovery symbiotic relationship. *Phytochemistry*. 55: 463- 480.

Govindarajan R, Vijayakumar M, Singh M, Rao, CHV, Shirwaikar A, Rawat AKS and Pushpangadan P. (2006). Antiulcer and antimicrobial activity of *Anogeissus latifolia. J. Ethnopharmacol*.106: 57-61.

Jagadish LK, Krishnan VV, Shenbhagaraman R and Kaviyarasan V. (2009). Comparative study on the antioxidant, anticancer and antimicrobial property of *Agaricus bisporus* (J. E. Lange) Imbach before and after boiling. *Afr. J. Biotechnol.* 8 (4): 654- 661.

Lodhia MH, Bhatt KR and Thaker VS (2009). Antibacterial activity of Palmarosa, Evening primrose, Lavender and Tuberose. *Indian J Pharm Sci*. 71(2): 134–136.

Nair R and Chanda, SV. (2007). Antibacterial activities of some medicinal plants of Western Region of India. *Turk. J. Biol*. 31: 231-236.

Nuran C Y and Olcay KI. (2012). Antioxidant properties of wild edible mushroom *Pleurotus eryngii* collected from tunceli province of turkey. *Digest. J. Nanomaterials and biostructures.* 7: 1647 – 1654.

Sai devi T, Jyothi Padmaja I, Nagendra Sastry Y and Nagamani A. (2012). A study on anti dermatophytic potential of selected ethno medicinal plants against *Trichophyton rubrum*, a common etiologic agent in and around Visakhapatnam region (India). *Asian Pacific Journal of Tropical Biomedicine*. S1874-S1878.

Sieradzki K, Wu SW and Tomasz A. (1999). Inactivation of the methicillin resistance gene mecA in vancomycin-resistant *Staphylococcus aureus*. *Micro. Drug Resist*. 5(4): 253-257.

Sorimachi K, Ikehara Y and Maezato G. (2001). Inhibition by *Agaricus blazei* Murill fractions of cytopathic effect induced by Western Equine Encephalitis (WEE) virus on VERO cells in vitro. *Bioscience, Biotechnology and Biochemistry*. 65 (7): 1645–7.

Taylor RSL, Manandhar NP, Hudson JB and Towers GHN. (1995). Screening of selected medicinal plants of Nepal for antimicrobial activities. *J. Ethnopharmacol*. 546: 153-159.

Tona L, Kambu K, Ngimbi N, Cimanga K and Vlietinck AJ. (1998). Antiamoebic and phytochemical screening of some Congolese medicinal plants. *J. Ethnopharmacol*. 61: 57-65.

Uzun Y, Atalan E, Keles A and Demirel, K. (2004). *Pleurotus eryngii* (DC. ex Fr.) Quel. ve Agrocybe cylindracea (DC. Fr.) Maire makrofunguslarının antimikrobiyal aktivitesi, M.S.G.S.Ü. Fen Edebiyat Fakültesi Dergisi, 4: 125-133.

Wasser SP. (2002). Medicinal mushrooms as a source of antitumor and immune-modulatory polysaccharides. *Appl. Microbiol. Biotechnol*. 60: 258-274.