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Research article

# Utilization of vegetable waste for biomass production of some wild edible mushroom cultures

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**Abstract:** A preliminary experiment was carried out to analyse the growth performance of six wild edible mushroom cultures using some chemosynthetic media and vegetable media in static culture condition. The chemosynthetic media used were Tien and Kirk medium, Mushroom complete medium, Yeast malt extract medium, Glucose yeast extract peptone medium, Malt extract broth medium and Sabouraud dextrose broth medium whereas vegetable peels, Drumstick peel medium, Potato peel medium, Carrot peel medium, Bottle gourd peel medium, Litchi peel medium, Papaya peel medium, Pointed gourd peel medium, Chopped grass medium, Little gourd peel medium, Pumpkin peel medium and Rich gourd peel medium were utilized for the preparation of media as well. Overall, Mushroom complete medium showed growth promoting activity as far as all mushroom culture concerned. However, Papaya peel, Drumstick peel, Carrot peel and Bottle gourd peel medium also exhibited as a good source of media for growth enhancement in case of *Russula*, *Lentinus* and *Pleurotus* sp. Present study exhibited the usefulness of vegetable peels and may be explored further for the cost effective technology for the biomass production.

**Keywords:** Macro fungi - Mushroom - Vegetables - Biomass.

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## INTRODUCTION

Mushroom fruit bodies are well known food items since ancient times and became important as nutraceutical and pharmaceutical agent now due to the capability of producing many useful secondary metabolites, high protien content with essential amino acids, vitamins, minerals and exopolysaccharides (Adebayo-Tayo *et al*. 2011). Though, mushrooms are demonstrated as potential source of many bioactive compounds, large scale production is the major constraints in order to fulfill the huge requirement of bioactive materials. However, mushroom fungal mycelium are the best source to be utilized for production of extracellular and / or intracellular bioactive compounds useful for formulation of nutraceutical and pharmaceuticals (Chang 2007). Many fungi and their mycelium biomass are reported as good source of food, protein supplement, lipid source and many more metabolites (Jong & Birgmingham 1993, Maziero *et al*. 1995, Moore & Chiu 2001). Similarly, several mushroom fungi have also been exhibited a good source of protein, carbohydrate and other secondary metabolites (Maziero *et al*. 1999, Caglarlrmak 2007). Recently it has been observed that submerged cultivation of mushroom mycelium in defined medium may also perform as good as mushroom fruit bodies (Yang & Liau 1998, Vieira *et al*. 2008, Joshi *et al*. 2013, Hamedi *et al*. 2007). Submerged cultivation methods are useful in mass scale production of many industrial compounds as well as advantages over the constraints of space and contamination. Many mushroom fungi are ligno-cellulolytic due to extracellular enzymes that can degrade the lignocelluloses into the favorable substrates (Howard *et al.* 2003). Complex sources of nutrients are not often used in large scale production of fungi. In addition, complex media helps in growth abundance may be due to unknown growth elicitor/compounds are present or slow rate of carbon and nitrogen metabolism (Crognale *et al*. 2003).

Keeping view the importance of waste material and their influences, a screening study has been planned to grow mushroom (wild) mycelium in different kind of kitchen waste and compared with synthetic media in order


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to obtain a good biomass as many wild mushroom are very difficult to grow in laboratory conditions though they are proved to be a good source of useful bioactive compounds.

## MATERIAL AND METHODS

Six wild edible mushroom cultures namely *Russula lepida*, *Russula brevipes*, *Russula nigricans*, *Pleurotus sajor-caju*, *Lentinus tuberregium* and *Calocybe indica* were used for the study of biomass production in different medium. All strains were maintained on Malt extract agar slants and the slants were incubated at 28°C for 7 days and then stored at 4°C for about 2 weeks. All stock fungi cultures were then transferred and maintained on Malt extract agar (MEA) plate by periodical sub culturing every one month. Both slants and plates were incubated at ambient temperature which ranged from 25–30°C for 5–7 days and then preserved at 4°C in refrigerator. Seventeen media namely chemosynthetic media (Tien and Kirk medium, Yeast malt extract medium, Mushroom complete medium, Glucose yeast extract peptone medium, Malt extract broth medium and Sabouraud dextrose broth medium) and vegetable media (Drumstick peel medium, Chopped grass medium, Carrot peel medium, Bottle gourd peel medium, Potato peel medium, Litchi peel medium, Papaya peel medium, Pointed gourd peel medium, Little gourd peel medium, Pumpkin peel medium and Rich gourd peel medium) were used for present study.

The seed culture of each organism (*Russula lepida*, *Russula brevipes*, *Russula nigricans*, *Pleurotus sajor-caju*, *Lentinus tuberregium* and *Calocybe indica*) was prepared by punching out 0.5 $cm^2$ of the agar-plate culture and transferred into tissue culture bottles.

For studying the effect of different medium on the mycelial biomass, 50 ml of each synthetic medium were dispensed in tissue culture bottles (pH maintained at 6.0), along with the basal medium (chopped plant products were distributed in particular amount in each tissue culture bottles) having 50 ml of distilled water, pH adjusted to 5.6 and sterilized at 121°C for 15 minutes, cooled down, then inoculated with the seed culture. All cultures were maintained at 30°C, for 14 days of incubation period. The mycelial biomass produced in each treatment was harvested by filtration to separate the culture broth and the fungal biomass was washed several times with distilled water, then air dried at room temperature until constant weight and represented as dry cell mass (DCM).

## RESULTS AND DISCUSSION

Fungi are endowed with the properties of organic waste decomposition in order to extract useful nutrient for their growth and development (Essien *et al*. 2005). In similar way, several studies have been carried out on the utilization of lingo-cellulolytic activities of fungi for the degradation of complex substrate into fermentable substrate ultimately that result into production of bioactive materials (Howard *et al*. 2003). To this effect, a study has been planned to compare the effect of vegetable waste materials with chemosynthetic media on growth of some mushroom culture under static culture condition.

Results depicted in table 1 regarding the growth of three species of *Russula* showed good growth of fungal culture in both the media types. However, *R. lepida* and *R. nigricans* exhibited comparatives good growth in Mushroom complete medium. *R. lepida* performed well in vegetable peel media prepared by Papaya and Pumpkin peels and data is very well comparable to the biomass of this fungi obtained in other synthetic media. Surprisingly, *R. brevipes* produced more biomass (0.615±0.02 g) in Papaya peel medium followed by Mushroom complete medium (0.349±0.05 g) and Glucose yeast extract peptone medium (0.392±0.09 g). *Russula nigricans* performed good in Papaya (0.244±0.02 g) and Little gourd medium (0.32±0.01 g) besides the Glucose yeast extract peptone medium (0.346±0.06 g), Tien and Kirk medium (0.257±0.03 g).

Growth performance of *Pleurotus sajor-caju*, *Calocybe indica* and *Lentinus tuberregium* has been presented in table 2. *Pleurotus sajor-caju* performed well in Glucose yeast extract peptone medium and Malt extract broth medium. However, good biomass was obtained in Potato peel medium also as compared to other chemosynthetic media. *Lentinus tuberregium* preferred Carrot peel medium and Bottle gourd peel medium besides Mushroom complete medium (0.506±0.04 g) and Glucose yeast extract peptone medium (0.362±0.21 g). Though *Calocybe indica* showed growth in vegetable media, chemosynthetic media were proved to be best for biomass production.

Overall, a good biomass of all mushroom cultures was also obtained in the media prepared by using kitchen waste *i.e.* vegetable peels and very well comparable to their growth performance occurred in chemosynthetic media used. The study presented a preliminary series of different media for the biomass production of

**Table 1.** Biomass production of *Russula* spp. under different liquid media.

| S.N. | Medium | Biomass production (g) | | |
|---|---|---|---|---|
| | | ***R. lepida*** | ***R. brevipes*** | ***R. nigricans*** |
| 1 | Tien and Kirk medium | 0.365±0.05 | 0.302±0.05 | 0.257±0.03 |
| 2 | Mushroom complete medium | 0.585±0.08 | 0.349±0.05 | 0.205±0.09 |
| 3 | Yeast malt extract medium | 0.399±0.004 | 0.257±0.05 | 0.176±0.01 |
| 4 | Glucose yeast extract peptone medium | 0.402±0.01 | 0.392±0.09 | 0.346±0.06 |
| 5 | Malt extract broth medium | 0.368±0.03 | 0.158±0.04 | 0.186±0.03 |
| 6 | Sabouraud dextrose broth medium | 0.416±0.01 | 0.169±0.04 | 0.164±0.02 |
| 7 | Drumstick peel medium | 0.066±0.003 | 0.122±0.07 | 0.160±0.05 |
| 8 | Potato peel medium | 0.115±0.02 | 0.046±0.01 | 0.156±0.03 |
| 9 | Carrot peel medium | 0.185±0.025 | 0.128±0.02 | 0.189±0.02 |
| 10 | Chopped grass medium | 0.1±0.01 | 0.065±0.01 | 0.073±0.02 |
| 11 | Bottle gourd peel medium | 0.135±0.003 | 0.077±0.02 | 0.137±0.02 |
| 12 | Litchi peel medium | 0.149±0.13 | 0.144±0.01 | 0.164±0.001 |
| 13 | Papaya peel medium | 0.417±0.0 | 0.615±0.02 | 0.244±0.02 |
| 14 | Pointed gourd peel medium | 0.032±0.002 | 0.055±0.01 | 0.042±0.01 |
| 15 | Little gourd peel medium | 0.044±0.01 | 0.029±0.06 | 0.32±0.01 |
| 16 | Pumpkin peel medium | 0.343±0.071 | 0.071±0.004 | 0.034±0.02 |
| 17 | Rich gourd peel medium | 0.103±0.011 | 0.047±0.013 | 0.066±0.02 |

**Note:** Where ± is average and standard deviation for three replicates.

**Table 2**. Biomass produced by *Pleurotus sajor-caju*, *Lentinus tuberregium* and *Calocybe indica* under different liquid media.

| S.N. | Medium | Biomass production (g) | | |
|---|---|---|---|---|
| | | ***P. sajorcaju*** | ***L. tuberregium*** | ***C. indica*** |
| 1 | Tien and Kirk medium | 0.295±0.14 | 0.244±0.08 | 0.22±0.03 |
| 2 | Mushroom complete medium | 0.261±0.33 | 0.506±0.04 | 0.262±0.13 |
| 3 | Yeast malt extract medium | 0.28±0.05 | 0.186±0.05 | 0.197±0.0 |
| 4 | Glucose yeast extract peptone medium | 0.460±0.20 | 0.362±0.21 | 0.217±0.18 |
| 5 | Malt extract broth medium | 0.388±0.19 | 0.11±0.02 | 0.22±0.02 |
| 6 | Sabouraud dextrose broth medium | 0.24±0.09 | 0.212±0.06 | 0.278±0.04 |
| 7 | Drumstick peel medium | 0.087±0.02 | 0.141±0.06 | 0.083±0.03 |
| 8 | Potato peel medium | 0.254±0.02 | 0.297±0.15 | 0.138±0.01 |
| 9 | Carrot peel medium | 0.156±0.02 | 0.407±0.15 | 0.15±0.01 |
| 10 | Chopped grass medium | 0.037±0.002 | 0.058±0.03 | 0.062±0.013 |
| 11 | Bottle gourd peel medium | 0.109±0.012 | 0.487±0.22 | 0.11±0.003 |

**Note:** Where ± is average and standard deviation for three replicates

mushroom cultures. Synthetic media is cost effective as presented in table 3. Malt extract broth medium costed Rs. 6.77 for 50 ml broth medium prepared followed by Sabouraud dextrose broth medium (Rs.5.118) whereas preparation of other chemosynthetic media required expenditure of less than Rs. 3.00 for 50 ml broth media in order to get biomass production. However, a good biomass of mushroom culture was obtained with no cost as the kitchen waste of vegetable peels was used.

**Table 3**. Expenditure occurred in preparation of 50 ml of chemosynthetic media.

| S.N. | Medium used | Expenditure per 50 ml of medium (In rupees) |
|---|---|---|
| 1 | Tien and Kirk medium | 1.26 |
| 2 | Mushroom complete medium | 0.84 |
| 3 | Yeast malt extract medium | 2.16 |
| 4 | Glucose yeast extract peptone medium | 1.85 |
| 5 | Malt extract broth medium | 6.77 |
| 6 | Sabouraud dextrose broth medium | 5.118 |

Since mushrooms are good source of bioactive compounds of anticancer, antifungal and anti-diabetic in nature, the mycelia may be used for the large scale production of the compounds as mushrooms are seasonal. To make the bioactive production technology cost effective, present study may be useful in order to obtain more biomass ultimately to have bioactive compounds in hand. Further standardization regarding quantification of substrate as nutritional source for biomass production and its cost economics is required to reach more constructive conclusion

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