**ABSTRACT**

In the era of increasing world population, shrinking lands and limited agricultural resources, edible mushrooms offer the promising substitute providing tenacity towards the problems of waste generation, food security, malnutrition and poverty. Edible mushrooms such as *Agaricus bisporus*, *Pleurotus* spp., *Lentinus edodes* etc. have been successfully explored for their production on various kinds of wastes including their nutraceutical enhancement, value addition and spent utilization for the compost preparation. Also, these mushroom species are well known for their unique significant pharmacological properties. Indigenous edible mushroom *Calocybe indica* grown in tropical and sub-tropical regions has also been emerged as one of the culinary mushroom providing great nutritional properties along with the marvelous therapeutic values. In spite having easy cultivation technology, good biological efficiency, great nutritional properties and huge revenues, the mushroom species has not been explored. The present study aimed to enhance the nutritional and nutraceutical properties of the *C. indica* mushroom by substrate enrichment using novel organic and inorganic supplements, post harvest treatments, their utilization for development of functional food product and propagation of the complete technology package developed to the selected rural areas.

Waste nitrogenous tree biomasses viz. *Bauhinia variegata* (BVL), *Syzygium cumini* (SCL) and *Cassia fistula* (CFL) were identified, collected and used as the co-substrate in varying proportions (0, 25, 50 and 75%) with the wheat straw (WS) for the production of *C. indica*. Results indicated that 25% BVL was the best co-substrate for producing highest yield (622g) and biological efficiency (82.93%) of *C. indica*. High contents of nitrogen presented in the CFL hindered the growth of *C. indica* and yielded poorly. Supplementation significantly (p<0.05) improved the protein, ash, fibers and minerals contents of the fruit bodies. Additionally, among the ten treatments, 25 BVL produced the fruiting bodies with high antioxidant properties followed by 25 CFL and 25 SCL. Significant degradation of complex material such as cellulose, hemicelluloses and lignin was scrutinized (quantitative and qualitative by FTIR) in all mushroom spent and found to support the growth of *E. fetida* earthworms, juveniles and cocoons. The vermi-compost produced after 70 days possessed good manurial values.

Inorganic supplements viz. essential mineral Fe, Zn and Se were utilized to improve the quality and quantity of *C. indica*. Preliminary studies identified the optimum doses for the
supplementation i.e. 6.25 ppm for Fe, 125 ppm for Zn and 5 & 10 ppm for Se for producing higher mycelial yield, which were then further carried out in the field for the production of mushroom fruit bodies. Bio-accumulation of the minerals studied using SEM – EDX was found to be in well correlation with the minerals estimated via ICP-MS. Further, antioxidant profiling estimated signified a negative correlation with the Fe enrichment, whereas Zn was found to increase the contents of TPC, DPPH and FRAP assays. Interestingly, Se was found to enhance the protein contents of the fruit bodies and hence evaluated for their amino acid profiling, HPLC graphs revealed increased chemical scores of glutamic acid (4.73 g/100g) followed by aspartic acid (1.80 g/100g), glycine (1.61 g/100g) and leucine (1.39 g/100g) in the 10 ppm Se treated mushrooms. Also, antioxidant studies examined showed a significant (p<0.05) increment in the TPC contents along with noticeable scavenging effects and ferric reducing capacities.

The fruit bodies harvested were further studied for their vitamin D\textsubscript{2} contents by experimenting with natural sunlight and artificial UVB light. The kinetic performed at different time intervals (0, 15, 30, 45, 60 and 90 minutes) revealed a linear increment of the vitamin D\textsubscript{2}. Both the sunlight and UVB radiation were able to improve the vitamin D levels, but significant high contents were recorded with the UVB treated mushrooms after 60 min of irradiations. Surprisingly appreciable amount of β-glucan (44.5 g/100g) was recorded with the fruit bodies irradiated under UVB source for 60 min. Further, these rays positively augmented the TPC, TFC, FRAP and DPPH radical scavenging activities along with the altered scores for all the seventeen amino acids analyzed of the treated fruit bodies. Nutraceutically enriched fruit bodies were further processed into the dried powder and studied for their hydration properties (WHC, OHC & WSI) and found appropriate for developing bakery product. C. indica powder (CIP) mushroom cookies were successfully formulated with a high acceptance of 10% fortification. Cookies were found rich in protein, fibre, minerals (Fe, Zn and K), and β-glucan contents as compared to the wheat flour cookies. Also, CIP incorporation increased the levels of TPC, TFC, DPPH and FRAP of the cookies and reduced the glycemic index of the same.

Propagation of the technology designed for C. indica mushroom was successfully carried out in the selected nine villages of Haryana. The program effectively resolved the problems of low income and availability of quality food from the respective areas. The farmers implemented the technique transferred and are willing to continue the activity for their future wellbeing.