ABSTRACT

One cannot imagine replacing 'Protein' from the diet by any other nutritional source. The essentiality of protein in the diet can be suggested from the fact that it is obligatory to consume protein regularly in the food for proper physical and mental development. The widening gap between demand and supply of the protein sources due to the increasing population and scarce resources has forced man to relentlessly pursue research for novel alternative sources of proteins. One such field is single cell protein (SCP). The field is gaining worldwide attention in the recent years.

In the direction of producing SCP from various microbial sources the capabilities of newly isolated local strain, *Scopulariopsis pram* MTCC 3553, were examined. Along with this the suitability of using annually and abundantly generated rice wastes as substrate for the cultivation of novel strain was studied. Further, the suitability of simple technique of solid state fermentation (SSF) was checked in terms of final protein yield. SSF technology is fast gaining recognition as an economically feasible alternative to the conventionally followed submerged fermentation (SmF) owing to its simplicity and user friendly techniques. The suitability of SSF for inexpensive SCP product was hence studied by comparing the behaviour of microbial growth by two techniques individually. The biomass produced after the fermentation process was used to extract SCP and downstream process, specifically for the isolated strain was standardized. The buffer for protein extraction was modified with supplements to help maximum total cellular protein extraction. To improve final protein yield various SSF parameters and environmental conditions were studied and were optimized with respect to the present lab scale conditions. The composition of SSF medium was also standardized to support the
maximum protein yield due to the microbe. Moreover, various extracts were also supplemented in the medium to check their suitability in causing further improvement in the final protein yield since even a fraction of improvement in yield means a lot in terms of industrial scale.

The final composition of the medium for effecting maximum protein production was composed of pretreated deoiled rice bran based medium with idealized CN ratio and nitrogen as well as phosphate content. The SSF parameters like thickness, moisture, inoculum size, particle size etc. were specific for the selected strain. Also the environmental conditions like temperature, pH etc. were optimized for the selected strain. The precipitation of the microbial protein improved the final protein percentage in the product. The yield due to these studies by SSF technology demonstrated a 39.1% protein content in the final SCP product after extraction as protein powder. The product also showed promising results in terms of amino acid composition along with low nucleic acid content, when compared to that of commercially available Spirulina product. Moreover there were a wide range of carbohydrates in the final product. It can hence be summarized to be a ‘wholesome’ nutrition with respect to the amino acid and carbohydrate content. The suitability of local food waste like rice bran for SCP production from the novel strain by SSF technology was highlighted in the present studies.

More specifically the dissertation has six chapters namely; Introduction, Review of Literature, Materials and Methods, Results and Discussions, Conclusions and Bibliography.
The first chapter deals with the protein resource crunch on national as well as global scale and dangers due to the growing population. The chapter focuses upon the importance of protein in diet and advantages of microbial protein source as an inexpensive alternative to the conventional protein sources to check the protein malnutrition. Further, an account of the correlation between waste utilization and SCP production was made. The objectives of present study, in the direction of waste utilization for the production of SCP are also highlighted in the chapter.

The second chapter deals with the literature reports regarding the study and the research work going on globally in the direction of SCP production. Various competent microbial strains for SCP production and suitable substrates are recorded. Also reported are the characteristics of the SCP production in terms of nutritive value, toxicity and genetic engineering to improve the suitable strains. The fermentation techniques especially the advantages of solid state fermentation along with specific substrates, suitability of fungi for the technique and various SSF parameters are surveyed in the literature. Downstream processing techniques and various methodologies followed are included. Finally the economic aspects of SCP production, its limitations and impact on solving global protein malnutrition is discussed.

The next chapter gives a detailed account of various experimental procedures followed along with the materials used in the process. The fourth chapter presents the results obtained and their analysis. The discussion regarding the results obtained is presented along with. The results are depicted in the form of graphs, tables, diagrams and plates. The chapter on conclusions discusses the suitability of present study and its role in solving protein malnutrition. The chapter in general summarizes the present study and
along with this it presents the recommendations for future work. The final chapter includes the bibliography for all the previous chapters.

The present study in the direction of SCP production for solving the global protein malnutrition is concluded to be successful and applicable under lab scale conditions. The study can also be conducted on pilot and industrial scale in the direction of commercialization of the protein product. Similar study can be performed to develop new strains as sources of SCP.

The experimentation and production in the same direction can be adopted anywhere in the world to utilize the local wastes for the production of inexpensive value added foods like SCP. This would utilize the waste and reduce the gap between demand and supply of protein products by augmenting the already available but costly conventional sources.