In conclusion, the present study which was basically dedicated to understand the nature of growth and development of *M. alpina* under different solid-state fermentation conditions. The isolation data showed that the distribution of *Mortierella sp.* as well as *M. alpina* was comparatively low compared to other species like *Aspergillus sp.* in the selected areas. Further, as implicated in various other studies TTC staining and low temperature isolation were highly specific as isolation tool with ITS sequence as the confirmatory one. The first comprehensive study carried to develop *M. alpina* seed culture, revealed that the agro-based ingredients are much efficient in promoting growth and development of *M. alpina* compared to currently used commercial ingredients both under liquid and solid based conditions. Glucose yeast extract media and potato dextrose medium were the best among the commercial seed culture preparation media. However, corn meal based agro media yielded three times higher the spore count along compared with commercial ingredients. Comparable results were also obtained when soy bean meal media was used. The results were quite similar when *M. alpina* was grown on the same set of commercial and agro-based media in the presence of agar.

Even though the sporulation was comparatively late when *M. alpina* was cultured under solid state conditions, profuse sporulation was observed on the 8th day, which was comparatively higher than commercial liquid and solid agar-based culture till the lag phase was observed. All the major physico-chemical factors had profound influence on ARA and lipid yield. Soy bean meal was the best substrate among the studied ones yielding the maximum ARA yield of 29.9 mg/g, with pH 6.0 as the most optimal one and initial moisture content of 70.0 % as the most ideal value.
Meanwhile, 10 days of duration yielded the maximum ARA, Corn Gluten was the best nitrogen source, 25°C as the ideal incubation temperature and with inorganic mineral mix with formula 3 as the optimal mineral supplementation. Also, the optimum inoculum size was found to be a volume of 3.0 mL with a spore count of 30 million CFU. Supplementation of oil which was also experimented, revealed flax seed oil as the ideal oil source. Further, all the B-complex vitamins substantially improved ARA yield with the maximum ARA production of 36.4 mg/g, 36.2 mg/g and 35.9 mg/g observed respectively with niacinamide, riboflavin and pyridoxine, with the first studied report on influence of riboflavin on ARA production. In the present study particle size was also found to be a major influential factor with 0.5 mm particle size yielding the maximum ARA. Other approaches including fed batch fermentation and continuous strategies also proved to be productive with significant improvement in ARA yield in both the studies. In addition, Erlenmeyer flaks-based fermentation was found to be the right choice for laboratory level fermentation. Among the various approaches studied to improve ARA production under solid state conditions, temperature shift strategy was the most fruitful with the maximum ARA yield found to be 41.5 mg/g. Statistical optimization which is considered as a basic requirement for product yield optimization was found to be extremely productive in the present study with the maximum yield of 41.29 mg/g of ARA obtained with basic composition including the solid substrate Soy bean meal, nitrogen source Corn Gluten, flax seed oil supplementation and inorganic mineral mix addition at statistically optimized levels. The present study is thus also the first report on
statistical optimization for ARA production under SSF. The study also described a novel and cheaper strategy for substrate media optimization using TTC staining. Cytotoxicity studies in presence of carcinoma cells revealed the possible role of *M. alpina* as an anticancer agent. The analysis of the final downstream processed solid substrate confirmed its stability under the proposed conditions. The LMSD process used to dry the fermented substrate was found to be the most efficient among the investigated strategies.

Cytotoxicity studies in presence of healthy cell line and carcinoma cell lines revealed the possible role of *M. alpina* as an anticancer agent.


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