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Solid State Fermentation: A Technological Alternative for Enriching Bioavailability of Underutilized Crops

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Abstract : Solid state fermentation, an eminent bioconversion technique for converting many biological substrates into a value-added product, has proven its role in the biotransformation of crops by nutritionally enriching them. Hence, an effort was made for nutritional enhancement of underutilized crops viz. barnyard millet, amaranthus and horse gram based composite flour using SSF. The grains were given pre-treatments before fermentation and these pre-treatments proved quite effective in diminishing the level of antinutrients in grains and in improving their nutritional characteristics. The present study deals with the enhancement of nutritional characteristics of underutilized crops viz. barnyard millet, amaranthus and horsegram based composite flour using solid state fermentation (SSF) as the principle bioconversion technique to convert the composite flour substrate into a nutritionally enriched value added product. Response surface methodology was used to design the experiments. The variables selected for the fermentation experiments were substrate particle size, substrate blend ratio, fermentation time, fermentation temperature and moisture content having three levels of each. Seventeen designed experiments were conducted randomly to find the effect of these variables on microbial count, reducing sugar, pH, total sugar, phytic acid and water absorption index. The data from all experiments were analyzed using Design Expert 8.0.6 and the response functions were developed using multiple regression analysis and second order models were fitted for each response. Results revealed that pretreatments proved quite handful in diminishing the level of antinutrients and thus enhancing the nutritional value of the grains appreciably, for instance, there was about 23% reduction in phytic acid levels after decortication of barnyard millet. The carbohydrate content of the decorticated barnyard millet increased to 81.5% from initial value of 65.2%. Similarly popping and puffing of horsegram and amaranthus respectively greatly reduced the trypsin inhibitor activity. Puffing of amaranthus also reduced the tannin content appreciably. Bacillus subtilis was used as the inoculating specie since it is known to produce phytases in solid state fermentation systems. These phytases remarkably reduce the phytic acid content which acts as a major antinutritional factor in food grains. Results of solid state fermentation experiments revealed that phytic acid levels reduced appreciably when fermentation was allowed to continue for 72 hours at a temperature of 35°C. Particle size and substrate blend ratio also affected the responses positively. All the parameters viz. substrate particle size, substrate blend ratio, fermentation time, fermentation temperature and moisture content affected the responses namely microbial count, reducing sugar, pH, total sugar, phytic acid and water absorption index but the effect of fermentation time was found to be most significant on all the responses. Statistical analysis resulted in the optimum conditions (particle size 355µ, substrate blend ratio 50:20:30 of barnyard millet, amaranthus and horsegram respectively, fermentation time 68 hrs, fermentation temperature 35°C and moisture content 47%) for maximum reduction in phytic acid. The model F- value was found to be highly significant at 1% level of significance in case of all the responses. Hence, second order model could be fitted to predict all the dependent parameters. The effect of fermentation time was found to be most significant as compared to other variables.

Keywords : composite flour, solid state fermentation, underutilized crops, cereals, fermentation technology, food processing
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