In search of the best technological solutions for creating edible protein-rich mutants: a multi-criteria analysis approach

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This paper used a multi-criteria decision analysis (MCA) method to evaluate different technological factors vital for creating protein-rich mutants. These factors are microorganism strains, agro-industrial waste substrates used as process feedstocks, AA inhibitors, and mutagenesis methods.

Introduction

Single-cell protein (SCP) is a promising alternative for replacing plant and animal-derived dietary proteins Improving these microorganism strains by enhancing their properties and productivity is vital to increasing SCP competitiveness. The use of AA inhibitors to promote selective pressure on SCP-producing strains is a novel concept and is not a widely explored approach, therefore, the further development of this method should be explored.
This study aims to compare and find the best alternatives for creating edible protein-rich mutants in four technological aspects. To achieve that (MCA) was used to identify the best alternatives in each group and find the “closest to ideal”. Finding the potentially best solution could be beneficial for developing a methodology for creating new SCP-producing mutant strains.

Methodology - MCA

Choosing alternatives and criteria → Literature analysis → Multi-criteria matrix → Weighting imporantce of criteria → Multi-criteria analysis (TOPSIS) → Ranking alternatives closest to ideal

Fig. 1. MCA methods TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) algorithm

Results

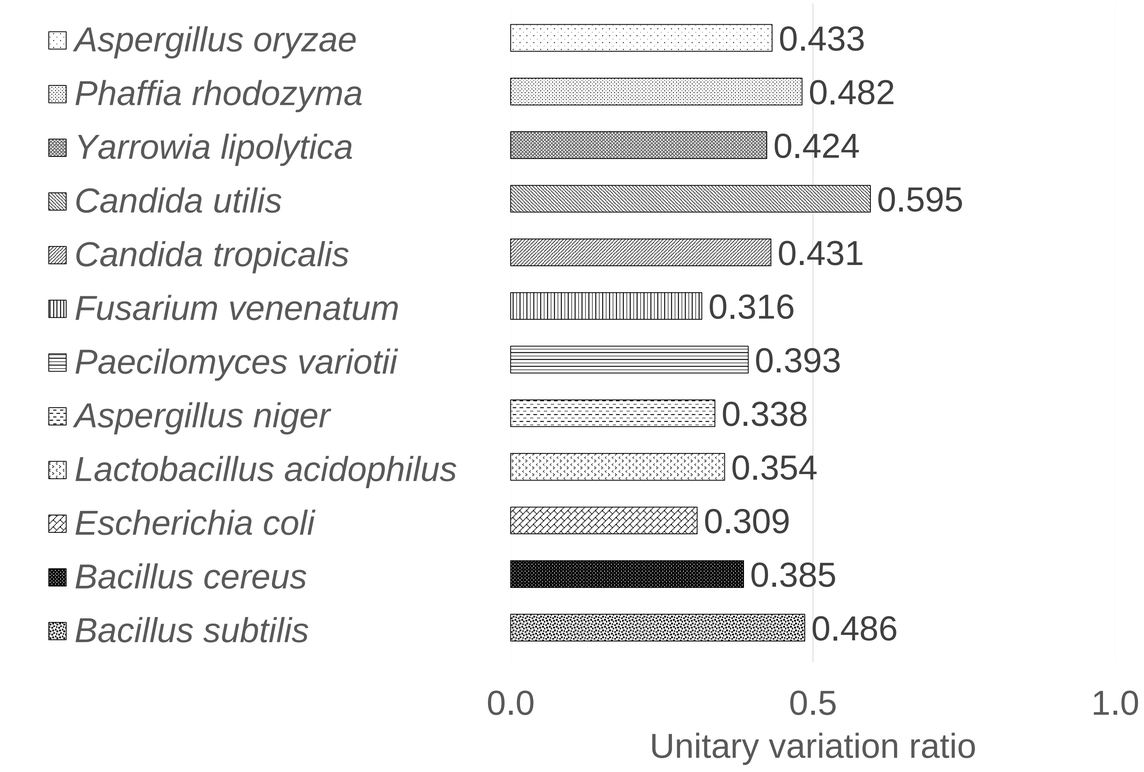

Fig. 2. MCA results for microorganisms

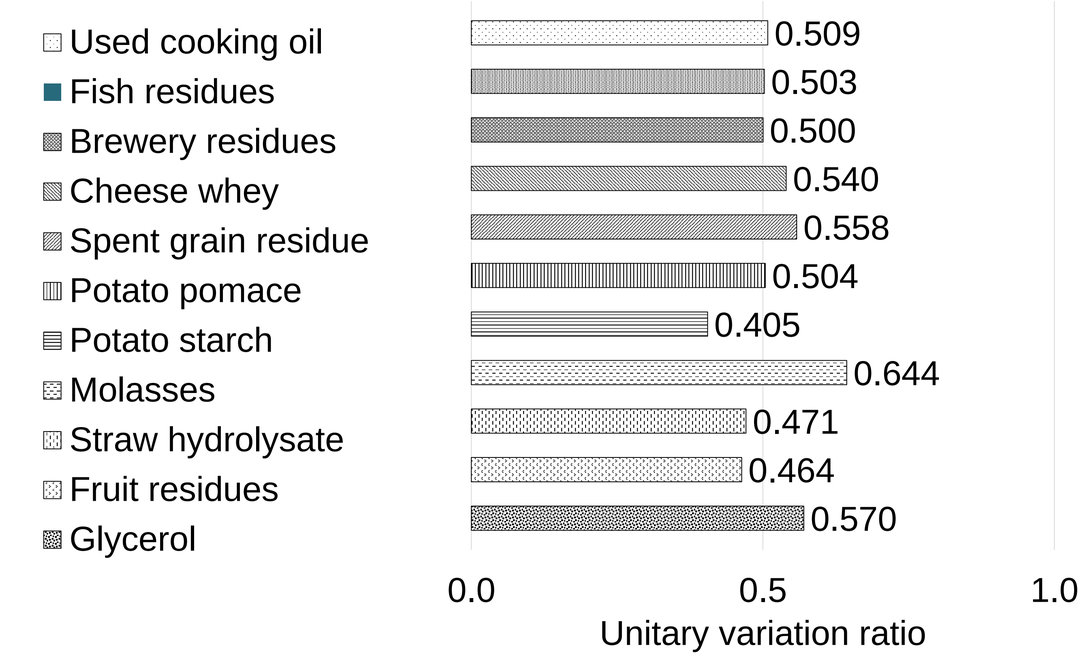

Fig. 3. MCA results for waste substrates

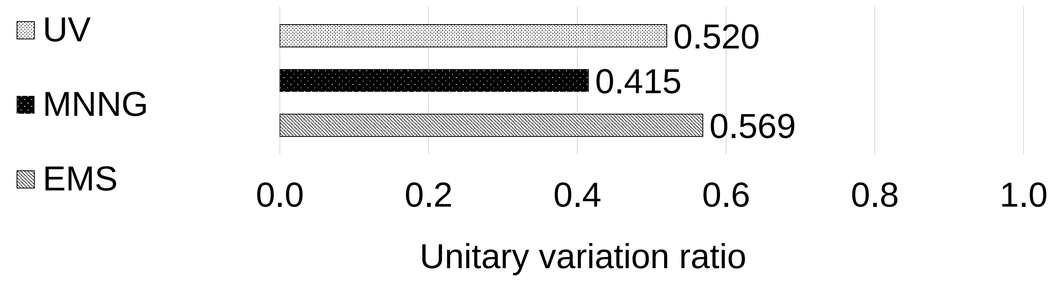

Fig. 4. MCA results for mutagenesis methods

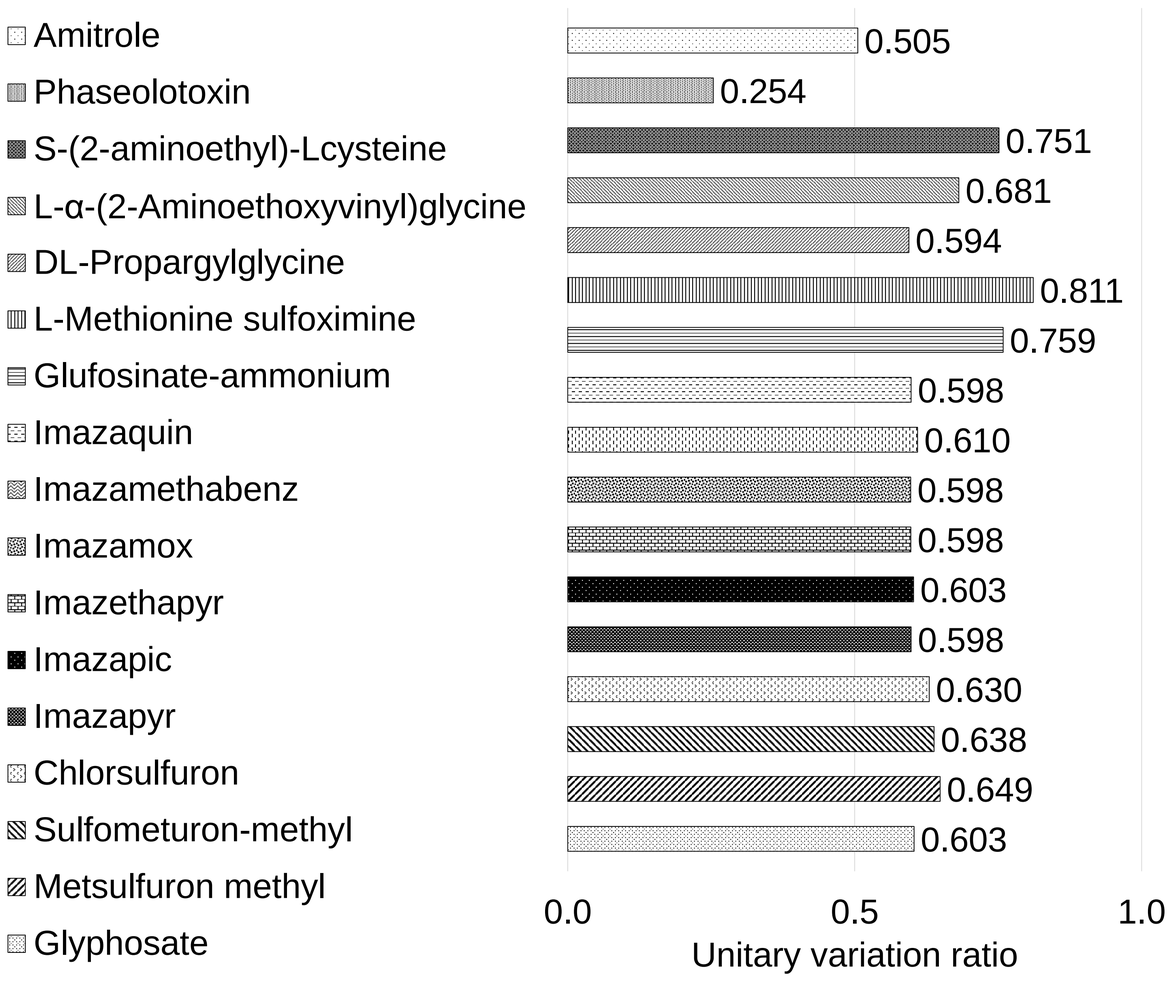

Fig. 5. MCA results for waste substrates

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Conclusions

- For microorganisms, two of the highest results were achieved by yeast species *C. utilis* and *P. rhodozyma*. From bacteria species *B. subtilis* gained the highest result and from fungi *A. oryzae*.
- From waste substrates molasses showed to be theoretically the best feedstock for SCP. Glycerol had the second-highest score.
- Mutagenesis with EMS was ranked as the closest to ideal by TOPSIS while UV mutagenesis was second and MNNG was last.
- The best inhibitors for both bacteria and fungi are four AA inhibitors: glufosinate ammonium, methionine sulfoximine, L-α-(2-aminoethoxyvinyl) glycine, and S-(2-aminoethyl)-L-cysteine

- Further research is needed on the combinations of more advantageous inhibitors such as glyphosate with metsulfuron methyl or another sulfonylurea, and glyphosate with propargylglycine.
- Identified potential combinations of microorganisms, substrates, mutagenesis methods, and inhibitors should be tested in a laboratory setting. Each of these combinations would require thorough testing and evaluation. The results of these tests should become the focus of future research papers.