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Comparison of Nutritional and Functional Properties of Single-Cell Protein from Saccharomyces cerevisiae and Soy Protein for Meat Substitute Applications.

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INTRODUCTION

The growing demand for sustainable protein sources has led to increased interest in single-cell proteins (SCP) derived from microbial biomass. Among them, *Saccharomyces cerevisiae* offers a promising nutritional profile and functional versatility for food applications. This study compares the amino acid composition and potential of SCP from *S. cerevisiae* with conventional soy protein, focusing on their suitability for use in meat substitute formulations.

MATERIALS AND METHODS

SCP was produced from *Saccharomyces cerevisiae* under controlled fermentation. Protein concentrate was obtained after heat treatment through alkaline extraction. Soypro900E from Shandong Crownchem Industries soya protein concentrate served as a reference (Shandong, China). Amino acid composition was determined by HPLC after hydrolysis, expressed in g/100 g protein and g/100 g concentrate. Nutritional composition (protein, fat, ash, moisture, carbohydrates, nucleic acids) was also analyzed.

Technofunctional properties were assessed using standardized methods: water and oil absorption capacities (WAC, OAC) via centrifugation; soluble fraction (SF) by protein quantification in supernatant; emulsifying activity and stability (EAI, ESI) through turbidimetry at 500 nm; foaming capacity and stability (FC, FS) by volume retention; and gelation capacity (GC) as the minimum protein concentration forming a stable gel upon heating and cooling.

RESULTS AND CONCLUSIONS

The amino acid profile per 100 g of protein and per 100 g of concentrate revealed that soy protein is richer in glutamic acid, aspartic acid, and arginine, which contribute to flavor (umami), solubility, and bioactivity. However, SCP showed higher levels of methionine and histidine—two essential amino acids often limiting in plant proteins (enhancing its nutritional value, especially when used in combination with soya).

From a nutritional standpoint, soy protein presented a higher protein content (85.4%) compared to SCP (78.8%), and a lower fat and carbohydrate content. Nonetheless, SCP had higher ash content, likely due to mineral richness, and measurable nucleic acids, which is typical in microbial proteins but should be monitored for dietary intake.

Functionally, soya protein showed superior water (355%) and oil absorption capacity (73.3%), indicating better performance in moisture and fat retention (desirable for meat analog texture). However, SCP exhibited higher emulsifying activity (EAI: 28.9 m²/g) and stability (ESI: 0.28 min), which are crucial for forming and maintaining stable emulsions in complex food matrices.

In foaming properties, soya clearly outperformed SCP, with higher foaming capacity (14.7% vs. 4.9%) and stability (21.3% vs. 4.5%), making it more suitable for aerated food systems. Gelation capacity (GC), on the other hand, was much higher for SCP (345.7 g/L), indicating a significantly lower gelling ability compared to soy (86.1 g/L).

In conclusion, while soya protein remains a benchmark for plant-based applications, SCP from *S. cerevisiae* presents a highly complementary profile: nutritionally robust (especially in methionine), technologically advantageous for emulsification, and a promising candidate for blending in high-protein formulations. Their combination could yield optimized plant-based meat substitute products in terms of nutrition, texture, and functionality.

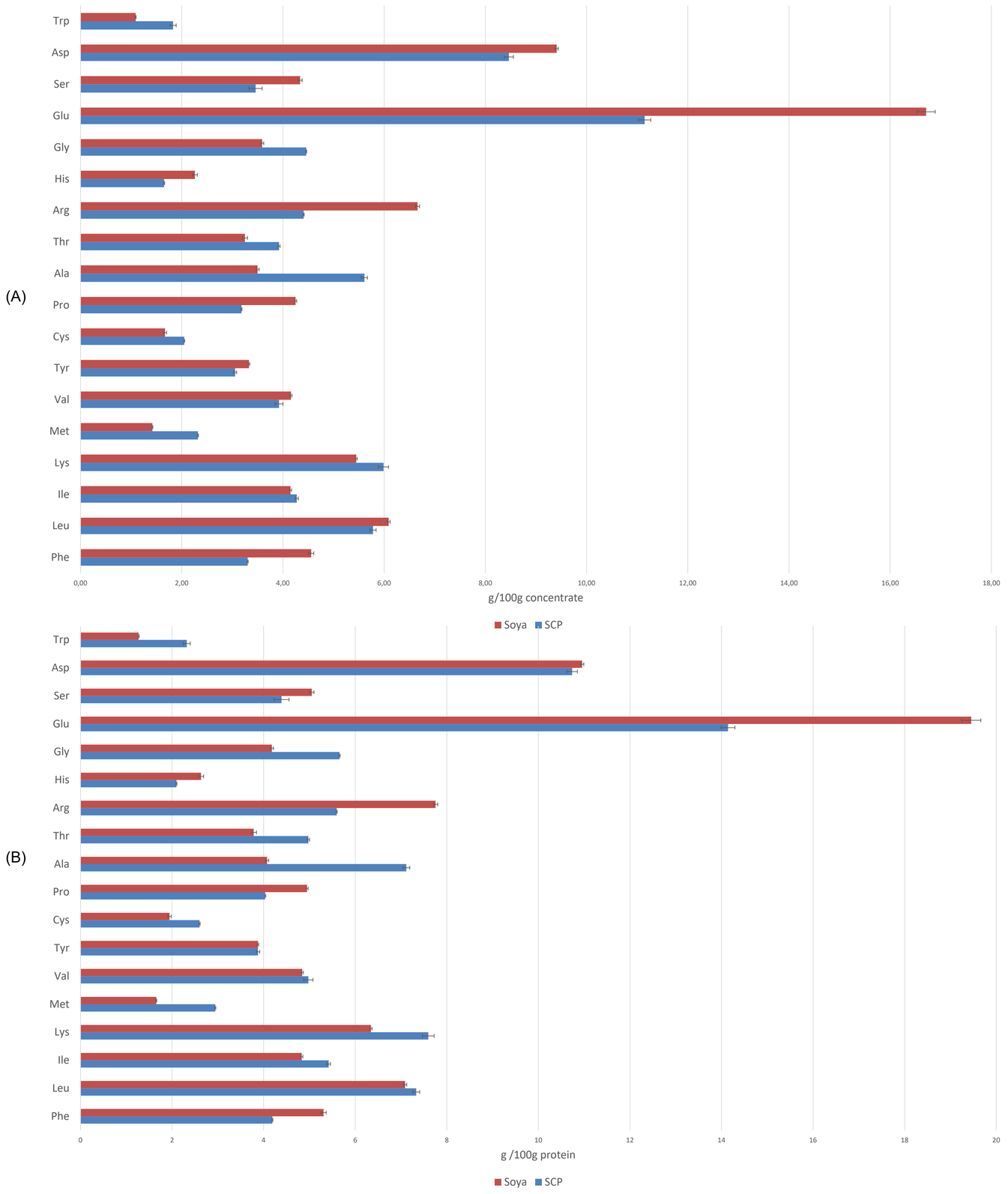

Figure 1. Aminograms of the SCP and soya protein concentrate: expressed as g of aa/100g concentrate (A) and g of aa/100g protein (B)

Table 1. Nutritional profile of SCP and soya protein concentrates

	SCP	Soya
Protein, %	78,83 ± 3,27	85,37 ± 5,41
Fat, %	1,1 ± 0,29	0,52 ± 0,12
Ash, %	7,4 ± 0,88	4,67 ± 0,39
Moisture, %	3,23 ± 0,25	5,26 ± 1,08
Carbohydrates, %	8,19 ± 1,10	0,36 ± 0,27
Nucleic acids, %	0.86 ± 0.93	< 0,5

Table 2. Functional properties of SCP and soya protein concentrates

	WAC, %	OAC, %	EAI, m²/g	ESI, min	FC, %	FS, %	GC, g/L	SF, %
SCP	138.3 ± 7.5	2.9 ± 0.5	28.9 ± 1.3	0.28 ± 0.13	4.9 ± 0.0	96.9 ± 0.0	345.7	4.5 ± 0.9
SOYA	355 ± 16.6	73.3 ± 2.5	26.6 ± 1.1	0.16 ± 0.11	14.7 ± 1.5	97.2 ± 0.1	86.1	21.3 ± 1.8

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