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Protein Hydrolysates as Affordable Serum Alternatives for Cultivated Meat Production

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BACKGROUND

Worldwide meat consumption is anticipated to rise by at least 6% in the next decade, driven by population growth and rising incomes [1]. Cultivated meat is emerging as a promising and environmentally sustainable alternative protein source.

However, one of the challenges in cultivated meat production is the use of fetal bovine serum (FBS) in cell culture media. FBS provides essential growth factors, hormones, and nutrients required for cell proliferation, but its use is unsustainable due to high cost, limited scalability, batch-to-batch variability, and ethical, safety, and regulatory concerns [2]. Therefore, developing serum-free media is crucial to enable the sustainable, safe, commercial, and ethical manufacturing of cultivated meat products. However, most available serum-free media are proprietary and expensive for large-scale food production.

Plant-derived protein hydrolysates represent a promising alternative to serum. They are cost-effective, safe for human consumption, and rich in peptides, amino acids, and bioactive compounds that can support animal cell growth and metabolism [3, 4]. Moreover, replacing serum with hydrolysates has the potential to reduce production costs, with study estimating that hydrolysates may be up to 15% cheaper than using pure amino acid components [5].

OBJECTIVES

This work aimed to investigate the use of plant-derived protein hydrolysates as serum replacement for cultivated meat production.

METHODOLOGY

1. Serum-reduction Adaptation

Commercial animal cell lines were gradually adapted to minimal-serum conditions by stepwise reduction of FBS in the culture medium.

2. Protein Hydrolysate Characterisation

Plant-derived protein hydrolysates were characterized for nutrient composition, including short-chain peptides, vitamins, amino acids, nucleosides, carbohydrates and fatty acids, using LC-MS–based analytical workflows.

3. Media Formulation

Serum-free media formulations were developed using a knowledge-based approach that integrated cell nutrient requirements with hydrolysate composition data.

4. Cell Proliferation and Cell Viability Assessment

The formulated media were tested for their ability to support cell proliferation under prolonged culture conditions.

RESULTS AND DISCUSSION

Novel methods of nutrients characterization of the components in hydrolysates were developed, such as short-chain peptide profiling. Novel short-chain peptides with growth-promoting and growth-inhibiting properties were also identified from the hydrolysates.

Adherent chicken cells cultured in hydrolysate-based, serum-free media were successfully cultured for at least 70 passages, exhibiting a doubling time of 1.53 days during the exponential growth phase. This formulation achieved a 75% reduction in media cost compared to conventional serum-containing media.

CONCLUSION

This study shows that plant-derived protein hydrolysates can serve as a viable, cost-effective, and food-grade serum alternative for potential cultivated meat production.

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