1. Project name

Nutritional Drink with Soy Protein Hydrolysate

2. Research Project Head and Co-researchers

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3. Origin and Significance

The production of tofu and soy milk generates a significant amount of soybean residue, much of which is discarded, while some is sold as low-cost animal feed. However, soybean residue is a nutrient-rich raw material, particularly high in protein, fiber, and calcium (see Table 1). It also contains isoflavones, known for their antioxidant properties[1]. This research aims to hydrolyze soybean residue using enzymes to produce high-value protein hydrolysates with low bitterness and high bioactive compounds, suitable for use in functional foods and health products.

4. Technology or Process

The development of soybean residue-derived protein hydrolysates involves a multi-step process, starting with material conditioning, followed by enzymatic hydrolysis, specifically by selecting and controlling the activity of endo- and exo-peptidases. This process induces the hydrolysis of peptide bonds in proteins, resulting in products composed of short-chain peptides and free amino acids, with a high degree of hydrolysis (DH > 20%). These hydrolysates display improved digestibility, enhanced antioxidant properties, and a pleasant flavor profile devoid of bitterness (see Figure 1 and Table 2).

5. Highlights or Originality of This Research

This research innovatively repurposes soybean residue, a waste material, into a novel and value-added functional food ingredient through enzymatic hydrolysis. The resulting protein hydrolysate is rich in short-chain peptides and free amino acids (see Figure 2), which exhibit enhanced bioavailability due to their ease of digestion and rapid absorption properties. Additionally, the hydrolysate demonstrates low bitterness, making it a highly palatable ingredient, and retains soy isoflavones bioactive antioxidant compounds, further enriching its nutritional profile (see Figure 3).

6.Utilization

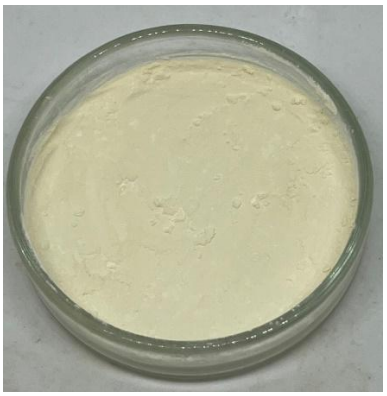
Protein hydrolysates derived from soybean residue can be used as a protein source in powdered nutritional drinks, which are typically imported and expensive. Utilizing this hydrolysate adds value to waste materials from tofu and soy milk production, while also reducing costs in the supplement food industry.

7. Tables and Figures

Table 1 The chemical composition of dried soybean residue

Chemical composition	Dried soybean residue
Moisture (g/100 g)	4.99 ± 0.10
Protein (g/100 g)	33.52 ± 0.06
Fat (g/100 g)	20.70 ± 0.01
Ash (g/100 g)	3.81 ± 0.10
Carbohydrate include Fiber (g/100 g)	36.08 ± 0.14
Calcium (mg/100 g)	346 ± 0.19

(a)



(b)

Figure 1 Protein hydrolysate from soybean residue using freeze drying (a) and spray drying (b)

Table 2 Properties of protein hydrolysate from soybean residue

Properties	Conditions of hydrolysis (%E/S*, incubation time)					
	0%, 1 hr	1%, 8 hr	3%, 2 hr	3%, 4 hr	5%, 1 hr	5%, 2 hr
Salt (%)	3.2	4.2	4.4	4.6	4.4	4.6
Degree of hydrolysis (%)	1.31	36.28	22.74	47.21	23.87	40.25
Antioxidant activity - DPPH (μM Trolox)	69.43	152.74	158.84	160.97	155.64	159.50
Yield (%)	5.44	25.17	20.76	23.52	21.49	22.68
Intensity of bitterness**	-	3.3 ± 0.82	2.8 ± 0.42	3.2 ± 0.42	3.6 ± 0.52	3.7 ± 0.67

***** E/S = enzyme/substrate

****** Sensory evaluation (bitterness) by the trained panel using the standard 10-cm line scale anchored (1 = not bitter และ 10 = extremely bitter)[2]

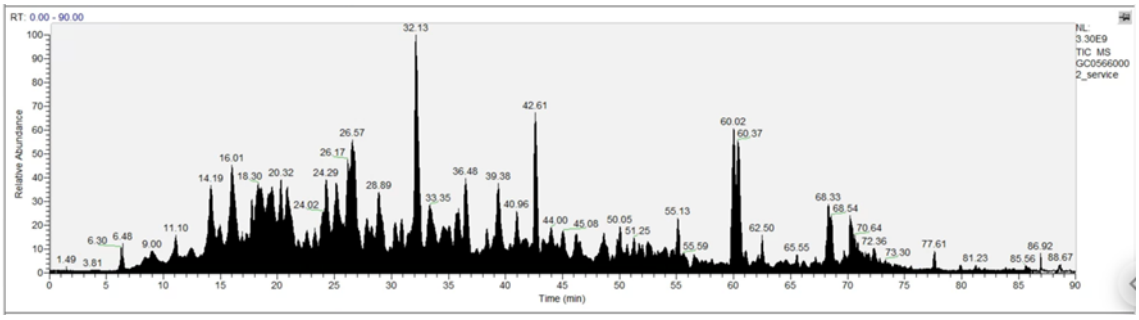


Figure 2 LC-MS/MS chromatogram of peptide analysis in protein hydrolysate from soybean residue

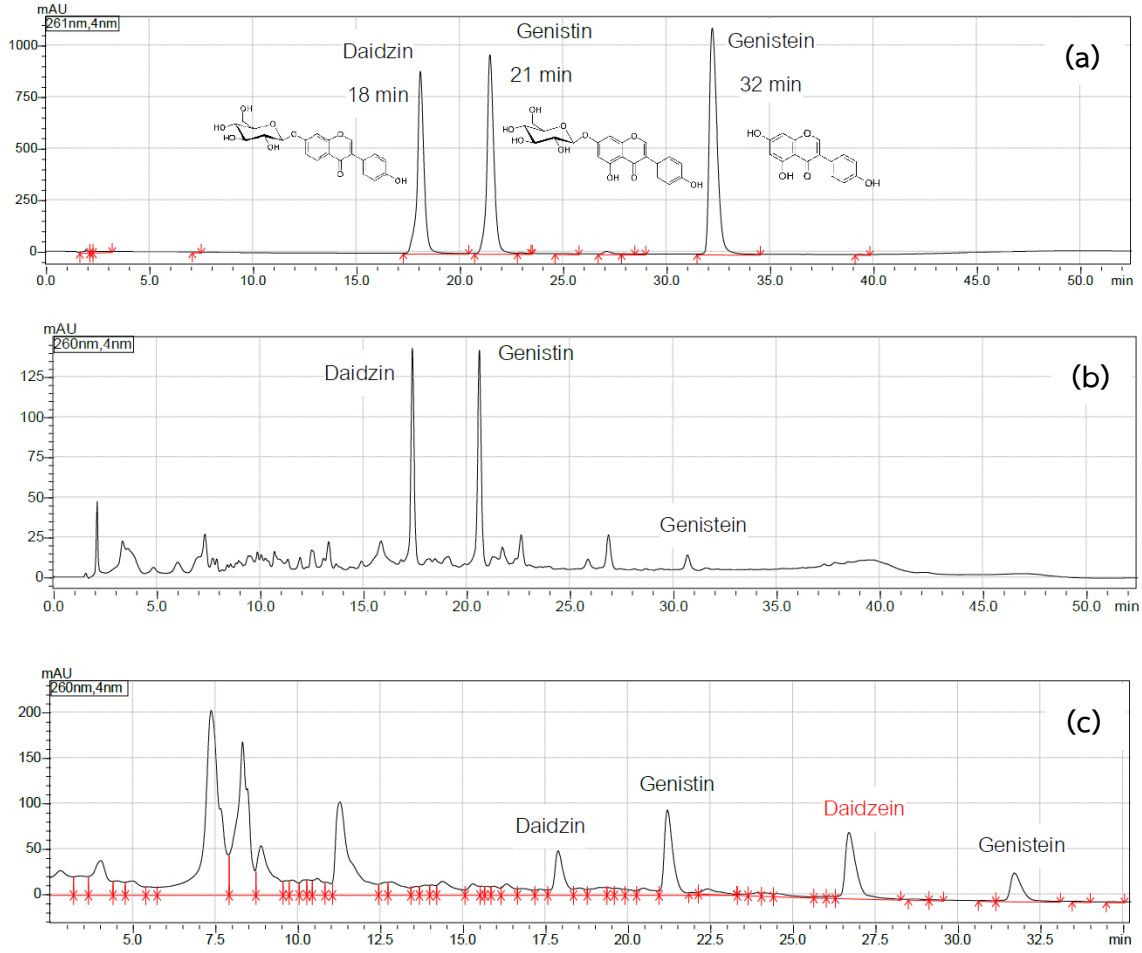


Figure 3 HPLC chromatogram of isoflavone standards (a), soybean residue (b) and protein hydrolysate from soybean residue (c)

8. Intellectual Property Registration Number

IP provisional of petty patent no.2303001975: Production process of protein hydrolysate from soybean residue using enzymes, with low bitterness and containing natural flavonoid compounds from soybean

9. Innovation pictures

10. References

[1] Silva, F.O., Miranda, T.G., Justo, T., Frasão, B.S., Conte-Junior, C.A., Monteiro, M., & Perrone, D. (2018). Soybean meal and fermented soybean meal as functional ingredients for the production of low-carb, high-protein, high-fiber and high isoflavones biscuits. *LWT - Food Science and Technology, 90*, 224–231.

[2] Meinlschmidt, P., Sussmann, D., Schweiggert-Weisz, U., & Eisner, P. (2016). Enzymatic treatment of soy protein isolates: effects on the potential allergenicity, technofunctionality, and sensory properties. *Food Science & Nutrition, 4*, 11–23.

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Business Model Canvas

Designed for:	*Designed by:*	*Date:*	*Version:*
Protein hydrolysates from soybean residue	Assist.Prof.Dr.Tita Foophow		

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
- Tofu or soybean milk manufactures (Raw material supply) - Food and beverage manufacturers - University for R&D - Distributors and e-commerce platforms	- Research and development for protein hydrolysate - Product development and processing - Branding and marketing - Logistics and distribution management **Key Resources** - Soybean residue supply chain - Enzyme technology - Personnel such as R&D and company employees - Production facilities - Strategic partnerships and funding	- Sustainable plant-based protein hydrolysate - High bioavailability and bioactive peptides - Supports health-conscious markets - Upcycled from waste, reducing environmental impact - Versatile applications: food, supplements, animal feed, pharma	- B2B collaborations and customized solutions - After-sales support and quality assurance - Educational content (blogs, webinars, research-based marketing) **Channels** - Direct supply to food, beverage, and nutraceutical manufacturers - OEM production - Trade fairs, expos, and industry conferences	B2B ex: food & beverage manufacturers (protein-enriched products) and nutraceutical and supplement companies

Cost Structure	Revenue Streams
- Raw material procurement - R&D and enzyme technology development - Manufacturing and operational expenses - Marketing, branding and customer acquisition	- B2B sales (bulk protein hydrolysate supply) - OEM manufacturing