Combatting NCDs using Plant-based Proteins and Animal-Waste Products

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Professor Apichart Vanavichit, PhD, a Rice Genomic Breeding Expert at the Rice Science Center, walks us through high-quality crop-based and ovo-based protein hydrolysates to combat non-communicable diseases in Thailand, specifically among its ageing population

The increasing incidence of non-communicable diseases in Thailand, specifically among its ageing population, is now a significant public health concern.

This situation may be associated with reducing protein intake among ageing people.

Older adults may find consuming high-protein beans and animal meats challenging to chew, digest and absorb. Low protein diets have been a leading cause of muscle loss and weakness among older people.

In addition, absorption of plant proteins may be blocked by antinutritive factors, such as trypsin inhibitors found in many tropical legumes and herbs. Diets with high caloric carbohydrates but low protein could lead to more obesity and type-2 diabetes. For these reasons, redesigning high-protein diets is sensible for the well-being of an ageing society.

Crop-based high-quality proteins

Protein content in plants ranged from < 2% (tuber crops and vegetables), 6-12% (Cereals) to > 22% (legumes). Nonetheless, a high-quality protein that judges the content of essential amino acids and absorption called The Protein Digestibility Corrected Amino Acid Score (PDCAAS) was developed by a joint FAO/WHO expert in 1989. The PDCAAS scores > 1.00 can be called high-quality proteins.

Although rice grains have approximately 6-8% protein content, they are low in lysine, methionine, and cysteine, which makes rice low in PDCAAS, unlike soybean.

Furthermore, a high-quality protein may consider its therapeutic properties against non-communicable diseases (NCDs) for ageing populations by delaying metabolic syndrome and enhancing anti-inflammatory, insulin sensitivity and immune competency.

For these reasons, pigmented rice bran and rice leaf may be considered better choices for high-quality protein rich in antioxidants, anti-inflammatory, dietary fibre, and micronutrients.

The protein research group at Kasetsart University Agricultural Product Development Institute, led by Dr Sukantharos Tadakittisan, has isolated nutrient-rich proteins from crops and unfertilised eggs to meet the goal.

They combined protein hydrolysate with enzyme technologies to isolate plant-based proteins with functional properties against metabolic syndrome from pigmented rice, soybean and mung bean.

For example, the enzymatic protein hydrolysates from Riceberry bran (RBPH) contained 19% highly absorbable protein showing anti-inflammatory, anti-diabetics, and antioxidants.

RBPH also showed potently suppressed survival of the liver cancer cell (Huh-7/SNU-449), the breast cell (MCF-7/MDA-MB-231) and the bile duct cell (KKU-100). In addition, RBPH protected cell lines from Lipopolysaccharide (LPS)-induced inflammation by reducing nitric oxide and cytokine IL-1β accumulation in vitro.

Pre-germination and fermentation induced additional nutraceuticals in rice, soybean and mung bean. Protein isolated from the germinated and fermented soybean and mung bean significantly reduced the size of peptides, enhanced anti-diabetics and phytoestrogen isoflavone aglycone.

Combining these isolated plant-based proteins, we created two nutraceutical products, Purple Protein Noodles and Instant Riceberry Protein Isolate. The 50g of the high-protein noodle contains 11g protein, 3.5g unsaturated fat, 3g dietary fibre, and 28g carbohydrate for only 200 kcal.

Additionally, the 35g serving size of the Instant Riceberry Protein Isolate contains 8g protein, 2g unsaturated fat, and 16g carbohydrate for 116 kcal only. The protein hydrolysate mix showed potent anti-diabetic effects by increasing the activities of alpha-amylase inhibitors and insulin-like proteins.

Still, it was also well perceived by most seniors as having a good taste and neutral smell. No arsenic nor aflatoxins were detected in the products. Therefore, these products are suitable as functional foods for delaying metabolic syndrome among ageing populations.

Turning wasteful eggs into high-quality proteins

Thailand is the third largest poultry exporter in the world. As a result, hatchery industries have created a substantial number of infertile eggs, up to 5-10%. Dead eggs are a good source of high-quality protein.

A speciality recipe, Kai Kao, created from unhatched eggs, has become a popular street food in Northeast Thailand.

However, the supply of unhatched eggs is several folds over their consumption. We have now turned these wasteful eggs into nutraceutical animal-based proteins for ageing societies. The pain point of using unhatched eggs in foods stemmed from the disgusting smell of these eggs.

Applying ultrasonic-assisted extraction and enzymatic digestion using bromelain and papain on unfertilised eggs successfully extracted highly absorbable, nutrient-dense protein (UFAP).

The UFAP contained 69% more protein and amino acids than regular eggs, particularly 81% more Lysine and 75% more Methionine. In addition, UFAP had three times more Retinol than 75µg RAE of 50g hard-boiled egg.

The microbial food safety is parallel to commercial white egg protein powder. The in vitro analysis of UFAP revealed enhancing anti-diabetes and supporting an immune system against NCDs in vitro.

Because animals convert 6kg of plant-based protein to make just 1kg of animal-based protein, it is more beneficial and environmentally friendly to develop high-quality plant-based proteins with nutraceuticals to cope with NCDs among ageing populations.

References

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Read Profile

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