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Indonesia's Potential of Natural Emulsifier from Coconut Protein Extraction in Skincare Lotion Application

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Introduction:

Indonesia is one of the three largest coconuts (*Cocos nucifera*) producers in the world. Indonesia's coconut production in 2018 reached 2.8 million tons, but most of it was exported in the form of unprocessed dry old coconut (copra). Coconut can be processed into coconut milk, which is an emulsion that is naturally stabilized by the presence of emulsifiers in the form of proteins and phospholipids.

The protein extraction process from the skimmed coconut milk phase can be carried out by the isoelectric precipitation method. Protein isolates can be applied as emulsifiers in lotion preparations. As an emulsifiers, Indonesia imports 23.5 thousand tons, so the presence of protein as a natural emulsifier from coconut has the potential to be used as emulsifier and is estimated to produce 12.9 thousand tons of coconut protein. It is expected to reduce by half the amount of emulsifier imports in Indonesia.

Materials & Methods:

I. Protein Isolate (Coconut Emulsifier) Extraction from Fresh Coconut

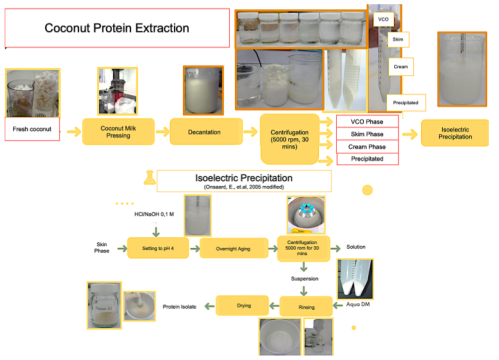


Figure 1. Protein isolate extraction process

II. Protein Isolate (Coconut Emulsifier) Application

Table 1. Formulation matrix

Formula	Control Variables	Independent Variable		
		Emulsifier	Oil	Dissolve pH of Emulsifier
FP001	Water Phase: • Aqua • EDTA • Allantoin • Glycerin Rheology Modifier: Sodium Polyacrylates Active & Preservative: • Tocopheryl Acetate • Phenoxyethanol • Ethylhexylglycerine	1% Protein Isolate (Coconut Emulsifier)	2% Castor Oil	6
FP002				8
FP003			2% Olive Oil	6
FP004				8
FP005		1% Hydrogenated Lecithin	2% Castor Oil	6
FP006				8
FP007			2% Olive Oil	6
FP008				8
FP009		Blank	2% Castor Oil	-
FP010			2% Olive Oil	-

III. Protein Isolate (Emulsifier) Evaluation

Table 2. List of evaluated parameter

Evaluation Method					
Dissolution Test of Protein (pH dependent)	Viscosity Check (Brookfield)	pH Check (Mettler Toledo)	Microscopic Check (Keyence VHX-700)	Accelerated Stability Test For 28 days (Room Temperature, Oven 45°C, Oven 50°C, Sunlight)	Sensory Evaluation (Spider Web Diagram)

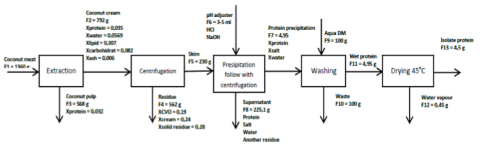


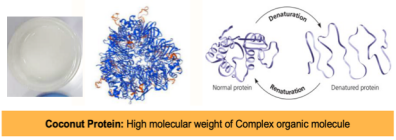
Figure 2. Mass balance diagram of protein isolate extraction process

II. Improve Dissolution of Protein Isolate (Coconut Emulsifier) in Water Phase

The pH setting was carried out before the emulsification process for all formulas with the aim of increasing the solubility in the aqueous phase so that during the emulsification process, coconut protein could form a film or thin layer between the oil and water surfaces. The solubility of protein improve at pH 6 – 10, but for the application in lotion formula, we used pH 6 and 8 (as isoelectric pH).

III. Application of Protein Isolate (Coconut Emulsifier) in Lotion

The viscosity of the protein isolate lotion (FP001-FP004) tends to have a smaller viscosity than lecithin lotion (±800 cP vs ±2000 cP). This can be caused by impurities from the extracted coconut protein isolate where from the test analysis results, the purity level of the extracted protein is only 57.5%.
In this study, protein coagulation with isoelectric precipitation through changes in pH is intended to open the folds of proteins and can be categorized as mild protein denaturation. Protein denaturation can increase the emulsion stability due to the hydrophobic groups exposed (unfolded), so it can interact with the oil phase.



Coconut Protein: High molecular weight of Complex organic molecule

Figure 3. Lotion with protein and protein emulsifier illustration

The stability of protein isolate as an emulsifier in lotion preparations was better than commercial hydrogenated lecithin. After 28 days of stability test, based on parameter change in pH, viscosity, and globule size, the most stable formula was FP004 (protein dissolution of pH 8, olive oil). Based on the sensory test carried out, it was found that from several test parameters there were similarities between one formula and another. However, there are differences in the parameters in the form of consistency and ease to pick up from several formulas. In terms of consistency, the formula with the code FP008 (lecithin, olive oil, pH 8) has a better consistency. In contrast, the formula with code FP002 (protein, castor oil, pH 8) had the lowest value of ease to pick up parameter because of the small value of consistency that is very runny, similar to the consistency of water.

Figure 4. Spider web sensory of lotion

Results & Discussion:

I. Mass Balance of Protein Isolate (Coconut Emulsifier) Extraction

An average of 1.36 kg of fresh coconut flesh was extracted to produce 792 g of coconut milk which was then separated using a centrifuge to obtain 230 g of skimmed coconut phase. The coconut skimmed was then proceeded to obtain 4.5 g of protein isolate which was then analyzed using the Kjeldahl method and the protein content of the extract was 57.5%. The following is a mass balance of protein isolation from the extract.

Conclusions:

- The average dry protein isolate was 4.5 g from 1.36 kg of fresh coconut flesh with a protein content of 57.5%.
- The better protein solubility in the water phase is at pH 6 - 10
- The viscosity of the formula using protein isolate was lower (±800 cP) than the lecithin emulsifier (±2000 cP).
- The stability of lotion using protein was better than commercial lecithin.
- The most stable formula after 28 days of stability test was FP004 (protein dissolution of pH 8, olive oil).

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