

TECHNICAL AND FINANCIAL STUDIES FOR CHOOSING THE RIGHT METHOD OF COCONUT MILK POWDER PRODUCTION : EFFECT OF TWEEN 80 AND SOY MILK CONCENTRATION

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Abstract

The Physico-chemical organoleptic and financial studies of coconut milk powder processed by Foam Mat Drying method were carried out. A randomized block design with two factors namely Tween 80 (0%; 0,4%; and 1%) as the first factor and dry soy bean milk concentrations (0%, 2%, and 5%) as the second factor was used to run this experiment. A multiple attribute was applied to select the best treatment for further financial studies.

The results implied that the best combination treatment was the use of 0,4% Tween 80 and 2% dried soy bean milk which produced a promising dried product having moisture content of 5,74%; FFA 0,54%; percentage solubility of 85,48%, Pay Back Period 3 years and 3 months, NPV= Rp. 7.910.389; and IRR = 67,08.

INTRODUCTION

Coconut fruit, a major source of vegetable oil is found abundantly in Indonesia. About 2.704.000 ton per year is produced annually (Peni, 1998). Beside being used as raw material for oil production, coconut fruit also being utilized as coconut milk or “Santan” for making several traditional dishes, snack and other food products. However, although processing of “Santan” has been carried out traditionally for centuries, technical processing into high valuable product to make it marketable still become the main hinderance.

A new approach to process coconut milk into “instant” product with low cost technology is considered beneficial not only reducing weight but also lowering the cost of transportation, easy to prepare extend the storage stability and make it possible entering the global market.

Commercial instant coconut milk has been produced using a Spray dryer method. However although this method is seemingly a simple operation but for successful operation, spray dried needed a skill person to operate. The application of this method at rural region may face several problems. A simple and cheap drying process to take place of spray drying method is therefore should be provided.

Foam Mat Drying method is a Fuel-Heated dryers, simple and easy to be carried out. In foam mat drying, the foam structure is very important during drying so that the dried mats can be scraped off and readily crumbled up into tiny pieces. The success of this process is depend to some extent on the suspension system. Coconut milk is an oil emulsified in water system where the component such as protein, fat, and sugar will be dispersed in water. All these component should be emulsified and stabilized the foam during drying and dispersed finely upon resuscitation in water (Chen and Dickinson, 1998).

The stability of this oil/water suspension is depend to some extent on the

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natural emulsifier absorbed between oil and water (Chen and Dickinson, 1998). Dried soy bean consisting of natural emulsifier which so called "lecithin" having a lipophilic property and could be combined by another synthetic emulsifier having a hydrophilic property to improve its HLB ("hydrophilic-lipophilic- Balance").

The aim of this study is to find out the best combination treatment of Tween 80 and dried soy milk concentration to make Coconut Milk Powder.

Physical and Chemical Analyses

The moisture content was analyzed with thermogravimetric method (Sudarmadji *et al.*, 1996). Determination of percentage solubility was done with a method reported by Hartomo and Widyatmoko (1993), organoleptic evaluation using a Hedonic Scale Scoring (Stone and Spigel, 1985).

Choosing the best alternative treatment

The best alternative treatment was measured using the method written by Hays (1993) and De Marle and Shlito (1993).

Financial Analyses

After the best treatment has been decided the final stage prior to the implementation of the project is the financial analyses. In this study the analyses carried out were the Internal Rate of Return, Pay Back Period and Net Present Value.

MATERIAL AND METHODS

Fresh peeled coconut was purchased from local market at Malang region. All the chemicals included Tween 80 and dried soy milk were obtained from Food Science and Technology Brawijaya University Malang.

Experimental Design

A Randomized Block design with two factors was used to carry out this study.

Two independent variables, namely Tween 80 Concentration (0%; 0,4%, 1%) and soy bean milk (0%; 2%; 5%) were examined their effect on physical, chemical, organoleptic as well as financial aspect. This experiment was repeated three times.

The experiment was arranged factorially as the following combination

A₀B₀ (0% Tween 80; 0% Soy Milk)
 A₀B₁ (0% Tween 80; 2% Soy Milk)
 A₀B₂ (0% Tween 80; 5% Soy Milk)
 A₁B₀ (0,4% Tween 80; 0% Soy Milk)
 A₁B₁ (0,4% Tween 80; 2% Soy Milk)
 A₁B₂ (0,4% Tween 80; 5% Soy Milk)
 A₂B₀ (1% Tween 80; 0% Soy Milk)
 A₂B₁ (1% Tween 80; 2% Soy Milk)
 A₂B₂ (1% Tween 80; 5% Soy Milk)

Coconut Milk Powder Processing

About 200 ml "Santan" was mixed with Tween 80 and dried soy bean milk, homogenized using Ultrasonic Homogenizer for 5 minute, and evaporated at 70°C until the volume of "Santan" reduced to 100 ml, the slurry was then placed in laminate film paper and then dried in oven at 50°C for four hours. The dehydrated "santan" was then grinded and mixed with maltodextrin in a ratio of 1:1 (b/b) then dried again for 3 (three) hours at 50°C. The dried product was then grinded and screened and analyzed.

ANALYSES

1. Organoleptic Evaluation

The organoleptic evaluation was carried using The Hedonic Scale Scoring (Stone and Spidel, 1985). About 20 (twenty) women from the Indonesian women organization of Indonesian State Bank Malang were asked to evaluate the product.

The organoleptic evaluation off all combination traetments is shown in Table 1 below:

Coconut Milk Powder
(Laksono and Kumalaningsih)

Tabel 1.
The average Score of Organoleptic Evaluation
of all Treatments

Treatments	Color	Performance	Turbidity
A ₀ B ₀ (Control)	6,95 h	4,75 bc	2,90 a
B ₁	6,75 fgh	4,80 bc	3,05 a
B ₂	5,85 bc	4,45 a	3,05 a
A ₁ B ₀	6,50 e	4,95 bc	3,05 a
B ₁	6,25 de	6,10 f	6,85 cde
B ₂	5,45 ab	5,65 d	6,90 cde
A ₂ B ₀	6,85 gh	5,20 c	3,05 a
B ₁	6,00 cd	5,65 d	6,95 de
B ₃	5,60 ab	4,95 bc	7,00 e

Note : A : Tween 80 Concentration
B : Soy Bean Milk

a. Color

The average value of color as shown in Table 1 above is in the average of 5,45-6,95. The organoleptic evaluation rated a panel of 5 persons using 1-9 scale.

- 1 = dislike extremely
- 2 = dislike very much
- 3 = dislike moderately
- 4 = dislike slightly
- 5 = neither like or dislike
- 6 = like slightly
- 7 = like moderately
- 8 = like very much
- 9 = like extremely

The total average is about $6,33 \pm 0,53$ (like slightly to like moderately).

Statistical analyses indicated that there was a significant difference among combination treatments. With the DMRT method it was observed that the use of Tween 80 at 0,4% and dried soy bean milk at 5% concentration had the lowest score and treatment without the addition of soy bean affected the color of dried coconut milk due to the extend of browning reaction obtained from the reaction between soy protein and some carbonyl compound of sugar found in the coconut milk.

Treatment without the addition of soy milk had better color.

b. Performances

It was considered reasonable that the combination treatments had significantly affected the performance of the coconut powder. As can be seen in Table 1 the best performance of the product was found in tretment A₁B₁ (0,4% Tween 80 and 2% soy milk). The texture of the dried product very smooth and no coarse granula was found. Apparently the concentration of Tween 80 and soy milk were in optimum condition as what stated by (Chen and Dickinson, 1998), that under the optimum condition natural and synthetic emulsifier may interact each other affected the consistency of the slurry prior to dehydration.

c. Turbidity

As affected the product showed in significant differences among treatment in the turbidity ratings. The best treatment A₂B₂ (Tween 80 1% and Soy bean milk 5%). The resolution of “coconut powder” in to water was very easy and dispersed evenly.

1. Physical and Chemical Analyses

a. Percentage Solubility

The percentage solubility of the “Coconut Powder” as shown in Table 4, was in the range of 55,41% to 85,88% (w/w) as illustrated in Fig 1. Tween 80 has the important role in the extend of resolution of the instant product.

b. Moisture and Free Fatty Acid Content

As indicated on Table 2. There was no significant interaction between treatments on the Moisture and FFA content.

Table 2.
The effect of Tween 80 Soy bean Milk an the Moisture and Fat.

Treatment Tween 80 (%)	Chemical Analyses		
	Soy Bean Milk (%)	Moisture Content (%)	FFA (%)
0	0	4,840	0,51
	2	5,130	0,51
	5	5,570	0,56
0,4	0	5,537	0,49
	2	5,130	0,54
	5	5,743	0,60
1	0	5,850	0,55
	2	5,193	0,60
	5	5,123	0,61

In this case the addition of natural (soy bean milk) and synthetic (Tween 80) emulsifiers not influence the chemical composition but may improve the mash surface tension hence increasing the evaporation rate so that the moisture content was considered low.

Comparison with the commercial coconut product processed by "Spray dryer" method, as depicted in Table 3, showed that the moisture and fat content of the experiment.

Table 3.
Comparison of the moisture and Fat content of Commercial an Experimental Instant Coconut products.

Products	Moisture content (%)	FFA content (%)
Commercial	2,25	0,12
Experimental Result	5,38	0,56

Result obtained from this study were higher than that of the commercial product. However the low cost and simple technology used in this study may be introduced at house hold level since it is easy and low investment cost. With the moisture content of 5,38% and FFA 0,56% this product is considered feasible to be carry out for local consumption.

Table 4.
The average Percentage Solubility of "Instant" Product.

Treatments	Average Percentage Solubility (w/w)
A ₀ B ₀	55,41
B ₁	66,41
B ₂	70,65
A ₁ B ₀	65,48
B ₁	85,48
B ₂	85,88
A ₂ B ₀	68,28
B ₁	81,13
B ₃	85,45

There was a significant interaction between treatments on the average percentage solubility ($P < 0,5$). The highest value was found in treatment A₂B₂ (1% Tween 80 and 5% Soy milk). About 85,88% of the dried product had been dispersed in the solution.

The Best Treatment Evaluation

Value analyses carried out in this study indicated that the use of 0,4% (v/v) Tween 80 and 2% (w/w) of dried soy bean milk was selected as the best treatment. As shown in Table 5, the value ratio was 0,382, which is obtained after the cost price of the product (Rp. 1.821,44) being divided with the total Performance Criteria Rank (699).

Table 5.
The value ratio of the treatments.

Treatments	Rank Total	Cost/product (Rp.)	Value Ratio
A ₀ B ₀	472	1,853	0,255
B ₁	465	1,804	0,252
B ₂	446	1,802	0,247
A ₁ B ₀	462	1,950	0,237
B ₁	699	1,821	0,382
B ₂	660	1,783	0,370
A ₂ B ₀	472	1,870	0,252
B ₁	601	1,924	0,312
B ₂	606	1,958	0,309

Note : A = Tween 80 Concentration
B = Dried Soy Bean Milk Concentration

Financial Analyses

1. Payback Periods

The Pay Back periods for the production of “Instant” Coconut Milk using 0,4% Tween 80 and 2% Dried Soy Bean Milk was 39 months or three years 3 mounths. This figure showed that the Pay Back Period of the was lower than that of the project requisite life which is about 10 (ten) years. Although the pay-back period is only a financial concept but based on this analyses it could be concluded that this treatment is considered feasible to be operated.

2. “Net Present Value”

The net present value of the best treatment was Rp. 7.910.389 for a rate of 65%. The positive Net Present Value indicated that the best treatment selected in this study may receive a promising benefit, if being carried out property.

3. “Internal Rate Return”

Internnal Rate Return of the best treatment was 67,08% which means that during the duration of the project life time it could return all the investment cost and achieve 67,0% profit per year. The value of the IRR of the best treatment was calculated at the 35% up to 40% interest thus this treatment is considered feasible to be operated.

CONCLUSION

1. The use of dried soy milk as foam stabilizer and Tween 80 shown a premixing result for the production of “Instant” Coconut Milk.
2. Foam Mat Drying Method could be applied to process Coconut milk into “Instant” product and considered feasible to be operated.
3. The use of 0,4% Tween 80 and 2% dried Soy bean Milk has a Pay Back Period of 39 months, NPV of Rp. 7.910.389 and IRR 67,08%

Recommendation

The facilities for drying should be equipped with an air blower to give a rapid dehydration of the foam slurry to get 2% moisture content for a layer 1/8” thick.

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