

Economic Analysis of the Conventional Production of Traditional Brem Food

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Abstract. The purpose of this study was to analyze the conventional production of traditional brem from the perspective of engineering and economic analysis. The engineering result showed that the process can be applied in industry in spite of using traditional method for processing the conversion of glutinous rice into brem via fermentation process. In short, the processes consisted of soaking, boiling, cooling, fermentation, pressing, stirring, stamping, cutting, drying, and packaging. To support the economic evaluation, several economic evaluation parameters were added, including gross profit margin, payback period, break even point, net present value, and cumulative net present value. To ensure the profitability of the project, initial mass of raw materials was tested from 20 to 100 kg of glutinous rice. The economic showed that the increases in the initial raw material give excellent tendency to the improvement of profit. However, the project must be followed by the innovation, since the economic evaluation revealed that the non-innovation project will result negative profit after 10 years of production. Interestingly, since the project involves small-scale production that use less labor, the present brem production can be classified as an attractive small industry.

1. Introduction

Brem is one of the traditional foods which is prepared from white glutinous rice using a dry-starter (called *ragi tape*) [1]. Brem is a dried, starchy, and sweet-sour rice extract. Since brem has high calorie, it is usually consumed as a snack [2]. This product is also trusted for skin health and increase the body warmth [1].

There are two kinds of brem, classified as solid brem and liquid brem. Solid brem has white to brown colour, no texture, soft, dry, and destroyed easily when edible in the mouth [3]. Liquid brem is produced from fermented mash of black/white glutinous rice using a dry starter [2]. Solid brem is well-known as Madiun brem and Wonogiri brem, whereas liquid brem is recognized as a Balinese brem which is an alcoholic beverage [1].

Before running brem food industry, feasibility studies about the establishment of the brem project is required. This study is expected to provide a basic description to the parties of capital owners to take the advantage of this business opportunity. The result of this study could also be used to decide whether the business plan should be feasible, delayed, or even canceled [4]. There are several ways to increase the production value of brem. One of them is trying to use cassava as an alternative raw



material instead of glutinous rice [5]. Glutinous rice has limitations in the supplies, while the cassava is abundant and inexpensive. Further, the price of cassava is dropped nowadays. The other method is to combine the glutinous rice and corn. This method is further effective for changing quality of solid brem, including color, flavor, texture, level of preference, water content, and acidity of solid brem [3].

Researches on the production of brem have been well-documented. However, no report has discussed the economic analysis for the production of brem with glutinous rice as a raw material. Here, the purpose of this study was to evaluate how to obtain the optimum production capacity for sustaining the brem production project. This economic analysis is important to decide where the production can be proceed with minimum production costs but gaining a considerable profit. The engineering analysis result replied that brem can be produced using the current commercially available technologies. The economic analysis showed that the profitability of the project depended on several factors. The economic evaluation is vary depends on the pay - back period, capital and operational cost, and electricity cost [6]. One of the effective methods that can be applied for boosting the profit is by increasing the production capacity. Although the enlargement of the production capacity can be easily estimated by mass balance calculation, this capacity relates to cost and some parameters of the production. To ensure the profitable of production, the whole processes were analyzed using several economic evaluation parameters, including gross profit margin (GPM), internal rate return (IRR), payback period (PBP), cumulative net present value (CNPV), and profitability index (PI) for sales to total investment cost. The results of this study can be used as support tool for development plan in Indonesia [6].

2. Methods

In this study, we analyzed the method for the production of brem with minimum costs but gaining a considerable profit. Data analysis in this study was adopted based on the sources from text books and papers or journals. The average prices of raw materials and some equipments (with their specification) for brem production were taken from the online shopping web to approximate the recent price of the materials. Then, all data were calculated using several economic evaluation parameters, including GPM, IRR, PBP, CNPV, and PI. Several assumptions were added to the calculation, in which these are described in the followed section.

3. Results and discussion

Figure 1 shows the process of making solid brem from glutinous rice as a raw material. The processing steps are divided into several steps. Initially, the raw material (glutinous rice) is washed and soaked for approximately 30 minutes in the container [6][7]. These processes aim to purify the raw material from dirt and impurities on glutinous rice. Then, the glutinous rice is cooked for 1 hour for changing the physical characteristics of glutinous rice (from hard into the soft). The materials are then cooled [8] until getting room temperature. During cooling process, the yeast powder is sprinkled gradually over the glutinous rice. For ensuring the yeast being spread out, the rice is stirring. Finally, the mixed rice and yeast was put into the fermentation process for 7 days until the glutinous tape is obtained.

The fermentation process is the important step in the brem production. This fermentation process consists of 4 decomposition steps. The first step is cracking starch molecules into dextrin and simple sugars. This process is called enzymatic hydrolysis. In the second step, the sugar from the first step is converted into alcohol. The third step, alcohol is turned into organic acid by bacteria *Pediococcus* and *Acetobacter* through the bacterial oxidation process. The last step is the reaction between some organic acids with alcohol to form a distinctive taste, which is known as ester.

Enzyme used for turning glucose into alcohol and carbon dioxide in the fermentation process is *zimase* enzyme, which is generated by *khamir* (*Saccharomyces cerevisiae*). Fermentation process in making brem can produce alcohol, pyruvic acid, and lactic acid. Pyruvic acid is the intermediate product, which is formed in sugar hydrolysis into ethanol and can be changed into ethanol or lactic acid. A change in pyruvic acid into lactic acid is catalyzed by *Pediococcus pentasaeus* bacteria [7].

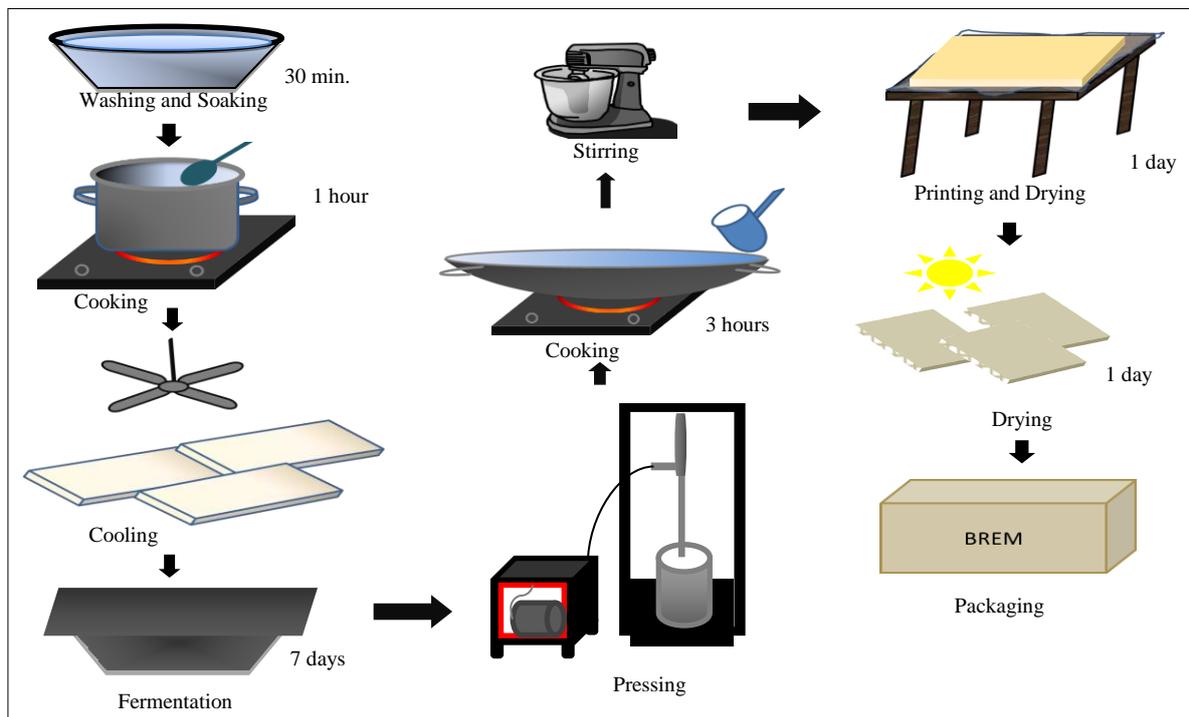


Figure 1. The Process of Making Solid Brem

After the fermentation process, solid product (*tape*) is pressed to get extract solution. The pressing process produces *tape* fluid (the extract), in which this is proceeded further to get solid brem. After the pressing process, the residue of *tape* is obtained, which can be utilized as a substituted material in the manufacture of other local products (such as *dodol*) [9]. The result of *tape* extract is then cooked until a semi-viscous liquid is obtained. Next, the liquid is mixed with soda and additive. The mixed liquid is then printed in the template and dried on the mold table for one day. After solidifying, the product is cut in accordance with the required size and dried for another one day to make brem dried and being durable. Indeed, the final brem product must be packed for sales. [7].

Based on the above process, calculation of mass balance needs some assumptions:

1. The formulation of making solid brem to fit the criteria with sweet sour taste, dry, hard texture, and yellowish white colour must be in the fixed condition. In the case of raw materials, the composition must be 20 kg of glutinous rice and 8.75 g of yeast [10].
2. Soaking could allow the hydration. Thus, additional heat is required. The amount of water absorbed in the soaking process is 30% [11].
3. Total absorption of water during the process is 35-40% [11].
4. The ethanol of fermentation is about 11-15% [12].
5. The brem processes obtain the extract of *tape* as much as 75% and the residue as much as 25% [13].
6. The calculation is used fix currency that 1 USD is equal to Rp 10,000.
7. The total production processing cycles are 96 times per year.

Based on the above assumptions, the result of the product with various quantities of raw material is shown in Table 1. Table 1 presents the value of GPM based on the quantity of raw material and the product. The highest GPM was detected when using glutinous rice of 100 kg, whereas the lowest GPM was resulted when using glutinous rice of 20 kg. The increase in GPM is strongly dependant to the amount of glutinous rice. Based on the GPM, the result showed that the production of brem is prospective to be applied for industry from engineering point of view. And, the glutinous rice was selected because of its abundant availability in Indonesia. [14-17]

Table 1. GPM in various quantities of raw materials

| Glutinous rice (kg) | Brem (kg) | GPM (USD) |
|---------------------|-----------|-----------|
| 20 | 14.79 | 21,389 |
| 40 | 29.58 | 42,873 |
| 60 | 44.37 | 64,358 |
| 80 | 59.16 | 85,842 |
| 100 | 73.95 | 107,327 |

To define the profitability of this production, other parameters must be added to calculate further economic evaluations. Additional assumptions must be made:

1. Wage and salary amounted to 5,222 USD for 4 workers per year.
2. The length of the operation is 20 years.
3. The discount rate is 15% annually.
4. The income tax is 10%.
5. This business does not loan the money from bank.
6. The sales are 2.80 USD for 160 g of brem.

Figure 2 presents the correlation of CNPV/TIC of the project time under various production capacities. Increases in the profit are obtained and a function of the production capacity. The most profitable project can be obtained when using 100 kg of raw materials. For all cases, the project is profitable until the 10 years and the profit decreases gradually from the 11th year. The main reason for the decreases in the profit after 10 years of production might be because of the innovation. Therefore, to gain the profitability of this production, elaboration and diversification the brem product with new flavours must be done. Indeed, this is the cheapest and best strategies since changing the shape or using other alternative raw materials will face more difficult ways. From Figure 2, we also could identify that the PBP could be reached on the 3rd year. This PBP is relatively short.

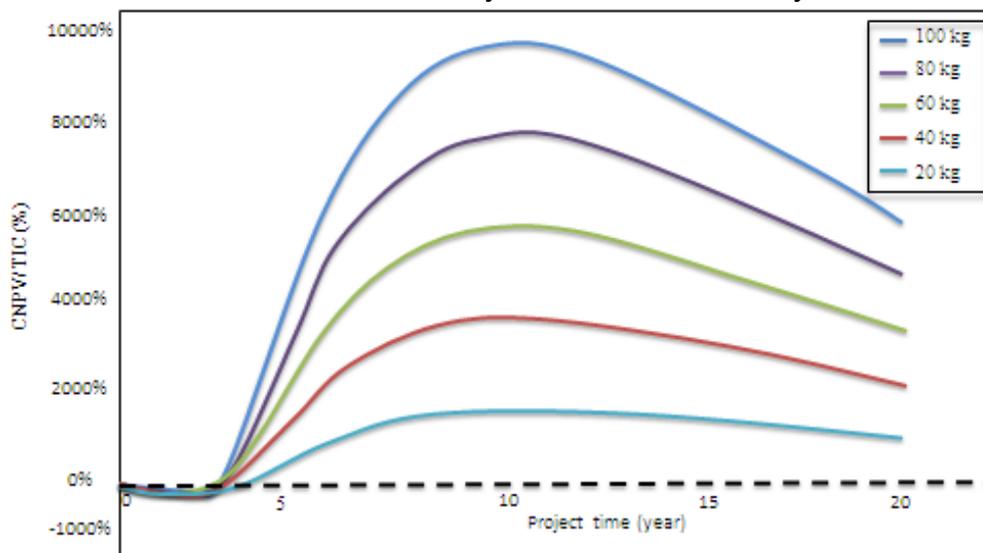


Figure 2. CNPV/TIC curve in accordance to project time with various glutinous rice. TIC is the total investment lost.

To confirm the profitability of the brem production as a function of production capacity, Table 2 presents in detail about PI, IRR, BEP, and last CNPV on the project. The value of PI and IRR increases with the improving production capacity. The PI is more than 1, which means that the project is profitable. Meanwhile, the value of IRR for each amount of product is more than 300%. Dividing by the total production in 20 years, the value of IRR is attractive compared to local bank interest rate. The value of BEP is different for each amount of raw material, decreasing with increases in the use of glutinous rice. The highest BEP could be reached when using 20 kg of glutinous rice. Meanwhile, the

lowest BEP could be reached in 100 kg of raw material. This BEP defines that the minimum production cycle for product must be more than 5 runnings for 20 kg of glutinous rice and must be more than 1 running for 60 kg, 80 kg, and 100 kg to avoid the losses. The latest CNPV/TIC for the projects was also considerable enough when using 100 kg of rice. Since the number of workers for this project is set to 4 people, the brem production can be classified as an attractive small industry. Indeed, applied the brem production with semi-modern method, more profit will be gained.

In addition, the present project is limited to the production of brem from 100 kg of glutinous rice. Indeed, more additional raw material would give positive impact to the improvement of profit. However, further additional raw material of more than 100 kg will face problems in the increasing other aspects, such as increasing the total investment as well as labor number.

Table 2. Analysis of IRR, BEP, and last CNPV on the project

| Initial glutinous rice (kg) | Brem (kg) | PI | IRR | BEP | Last CNPV/TIC |
|-----------------------------|-----------|----|------|-----|---------------|
| 20 | 14.79 | 5 | 315% | 5 | 8% |
| 40 | 29.58 | 14 | 335% | 2 | 20% |
| 60 | 44.37 | 24 | 346% | 1 | 32% |
| 80 | 59.16 | 33 | 353% | 1 | 44% |
| 100 | 73.95 | 43 | 359% | 1 | 56% |

4. Conclusion

Brem production has been evaluated from economic evaluation study. The economic evaluation presented the profitability of this project. To improve the quantity of profit, the amount of glutinous rice must be improved. We found that the profit will be obtained when using the amount of raw material of 100 kg. However, the CNPV result showed a parabolic graph, informing the need of additional innovation for this product after several years of production.

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