

Utilization of Edamame (*Glycine max* (L.) Merr) And Red Bean (*Phaseolus vulgaris*) As A Functional Beverage

Melanie Cornelia, Soraya Triesly Lessy

Department of Food Technology, Faculty of Science and Technology, Pelita Harapan University, UPH Tower, B Building, Karawaci, Tangerang 15811 Indonesia

*Corresponding author. Email Addresses: melanie.cornelia@uph.edu

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ABSTRACT

Indonesia had the big potency to produce red beans and edamame beans, but its utilization regarding functional food was not optimal. This research was intended for development combining red and edamame beans to become a new functional beverage product. The ratio of edamame milk to red bean milk (100:0, 75:25, and 50:50) and cooking temperature 90 °C has been selected based on SNI soymilk. During storage, a phase separation happened. Consequently, stabilizer should be added to improve its stability. Three types of stabilizers were used, CMC 0.1 %, 0.2%, and 0.3 %, xanthan gum (XG), and guar gum (GG) 0.025 %, 0.05 %, and 0.1 %, respectively. The best formulation was milk ratio 75:25 with 90 °C and addition of XG 0.05 %. The dietary fiber analysis for milk formulation was 4.46 % therefore it was categorized as a functional beverage.

Keywords: *dietary fiber, edamame, red bean, functional beverage, xanthan gum.*

ABSTRAK

Produksi kacang merah dan kedelai Indonesia sangat potensial, namun pemanfaatannya sebagai pangan fungsional masih kurang. Penelitian ini bertujuan untuk mengembangkan kacang merah dan kedelai sebagai produk baru makanan kemasan. Perbandingan antara susu kacang merah dan kedelai (100:0, 75:25, and 50:50) dan temperatur pemanasan 90 °C telah dipilih berdasarkan SNI. Selama proses penyimpanan terjadi fasa pemisahan sehingga senyawa penstabil perlu ditambahkan. Tiga tipe stabilizer yang digunakan adalah CMC 0.1 %, 0.2%, dan 0.3 %, xanthan gum (XG), dan guar gum (GG) 0.025 %, 0.05 %, and 0.1 %. Formulasi susu terbaik diperoleh dengan perbandingan 75:25 pada suhu 90 °C dan penambahan XG 0.05 %. Analisis serat makanan formula susu menunjukkan 4,46 % sehingga dapat dikategorikan sebagai pangan fungsional.

Kata kunci: *serat makanan, kedelai, kacang merah, pangan fungsional, xanthan gum.*

INTRODUCTION

Edamame beans (*Glycine max* L. Merr) and red beans (*Phaseolus vulgaris*) were high in protein and food fiber. Edamame beans contain high protein 10.0-10.9 grams or equivalent to 22 % daily intake and food fiber contained as much as 5.2-6.82 grams in 100 grams [1,2], which meet the requirements of high-protein foods (foods with protein exceeding 20 % of daily energy value) and sources of dietary fiber (foods that exceed 3 grams per 100 grams). In addition, edamame nuts were also contained many vitamins and minerals, such as iron, calcium, potassium, phosphorus, magnesium, folate, vitamins A, B1, B2, B3, C, E, and K [3]. Edamame in Indonesia located in soybean barn, Jember (East Java) were 42 % of national soybean production. People consume 100 grams of legumes provide 20 % protein and

10 % dietary fiber per day [4]. Nowadays, red beans were processed to be soup, and complement dessert, but people tend not to consume red beans because of its unpleasant smell. In addition, protein content of edamame is higher than red bean. Therefore, this research studies the possibility for functional food development by combining red beans and edamame beans to create a new functional beverage product. Soymilk was a water extract of soybean, with or without permitted additive. However, during storage, a phase separation occurred, consequently, the stabilizer was often added to improve its stability. In this research, the ratio of edamame milk to red bean milk and cooking temperature with addition of stabilizer has been observed.

MATERIALS AND METHODS

The raw materials were used edamame bean, red bean, and drinking water. Chemical were used such as H₂SO₄, K₂SO₄, NaOH 50 % (w/v), NaOH 4N, boric acid, H₂O₂, HCl 0,2N and hexane. The equipments were used analytical balances, blender, stove, stainless steel pan, desiccator, thermometer, furnace, Soxhlet apparatus, viscometer, pH meter, and equipment for protein analysis (Kjeldahl).

Research Stages

This research was divided into two stages. Stage 1 began with the production of edamame milk (Fig. 1) and red bean milk (Fig.2). Research stage 1 was aimed to select three ratio of edamame milk (EM): red bean milk (RBM) and one optimum cooking temperature that refer to soymilk quality standard (SNI 01-3830-1995) [5]. The production of red bean milk based on modified procedure from Sharma *et al.*, [6], whereas the production Edamame Milk applied the modified procedure by Onourah *et al.*, [7] dan Angraini & Yuniarta [8.]

Research stage 2 was done to determine the most effective stabilizer to improve the stability of edamame and red bean milk functional beverage. Three types of stabilizers (CMC, xanthan gum (XG), and guar gum (GG)) were used independently to each ratio selected. CMC were added by 0.1 %, 0.2 %, and 0.3 %, while XG and GG 0.025 %, 0.05 %, and 0.1 %. These selected formulations were analyzed for hedonic test and dietary fiber. The beverage with the most preferred formula was selected for proximate analysis and observation of the shelf-life. Proximate Analysis of Raw Material was depicted in Table 1 and Table 2.

Table 1. Proximate analysis of edamame bean

Parameter	Edamame Bean [2]	Fresh Edamame Bean
Water (%)	71.35	65.68 ± 1.55
Protein(%)	12.95	11.80 ± 1.24
Fat(%)	5.20	3.53 ± 0.48
Ash(%)	1.27	1.80 ± 0.19
Carbohydrate(%)	10.50	17.20 ± 2.53

Table 2. Proximate analysis of red bean

Parameter	Red Bean [2]	Fresh Red Bean
Water (%)	66.94	56.61 ± 0.69
Protein(%)	8.67	10.15 ± 0.80
Fat(%)	0.50	1.93 ± 0.48
Ash(%)	1.09	1.99 ± 0.24
Carbohydrate(%)	22.80	29.33 ± 1.67

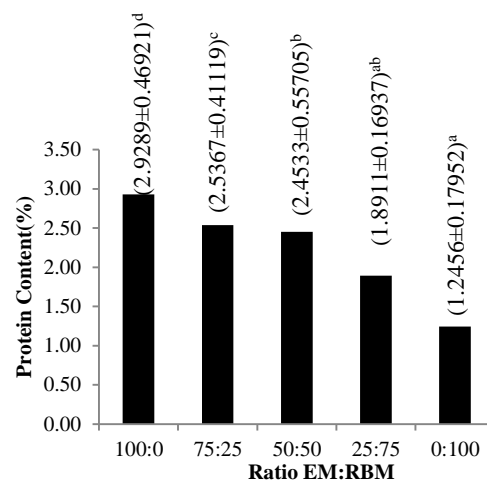


Figure 3. Ratio of EM : RBM versus protein content

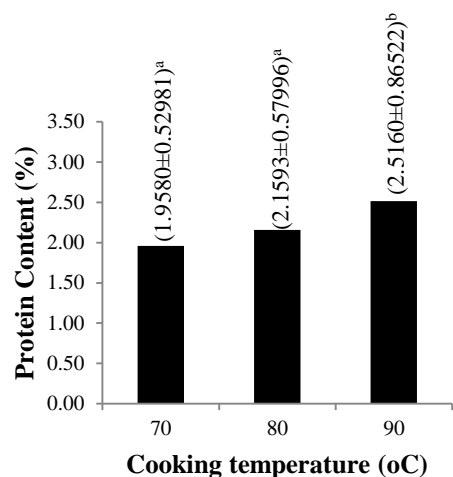


Figure 4. Cooking temperature versus protein content. Different superscript notation letter shows significant difference ($p < 0.05$)

RESULT AND DISCUSSION

Effect of Ratio Edamame Milk (EM) to Red Bean Milk (RBM) and Cooking Temperature toward protein content

The result of statistical analysis showed that there was a significant different ($p < 0.05$) on ratio EM to RBM and cooking temperature towards protein content. However, there was not a significant different on interaction between ratio EM to RBM and cooking temperature.

The higher protein content obtained from 100 % EM. This was due to the protein content of edamame bean (11.80 %) was higher than red bean (10.15 %). Fig 4 showed that higher cooking temperature gave the higher protein content. Cooking 90 °C obtained the

highest protein content. Shurtleff and Ayogi [5] explained that cooking temperature at 90 °C could increase the quality of sensory and nutrition of the soymilk

Effect Ratio Edamame Milk to Red Bean Milk and Cooking Temperature to Total Solid and pH of Edamame and Red Bean Milk

The result showed that there was significant different of ratio edamame milk to red bean milk, cooking temperature, and interaction between these factors. Figure 5 showed that the highest total solid obtained from EM : RBM of 50 : 50, then 100 : 0 and 75 : 25 with the

cooking temperature is 90 °C. Based on soymilk quality standard (SNI 01-3830-1995), the total solid must be achieved min. 11.50 %. Total solid at 90 °C is achieved about 9.89 %-17.90 %. The higher cooking temperature gives higher total solid.

The result Fig 6 showed that there was no significant difference of pH in each treatment. The pH was in range 6.70±0.16 - 6.75±0.16. The production of edamame milk and red bean milk did not give any effect in pH. Based on quality requirements of soy milk (SNI 01-3830-1995), pH 6.5-7.0 should be achieved [5].

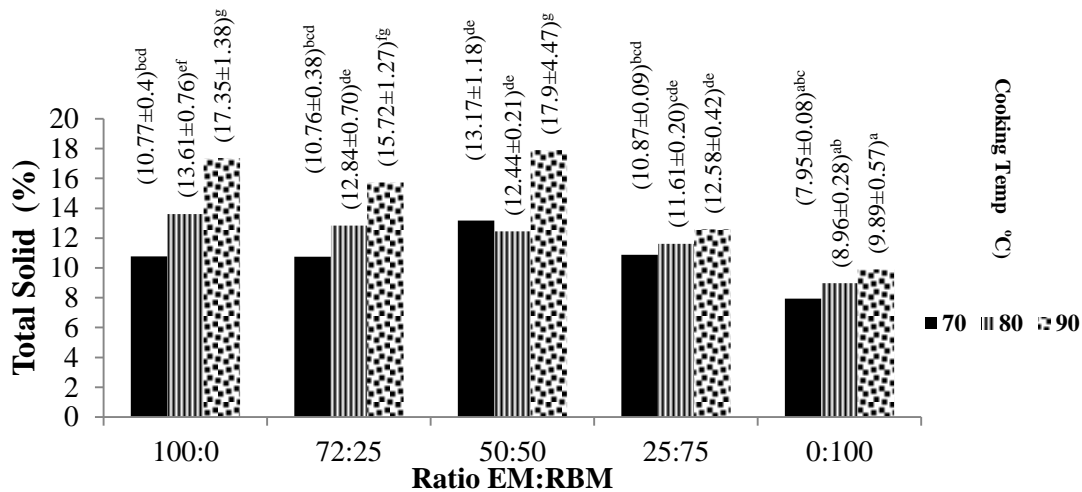


Figure 5. Ratio EM : RBM and Cooking Temp towards Total Solid. Different superscript notation letter shows significant difference (p<0.05)

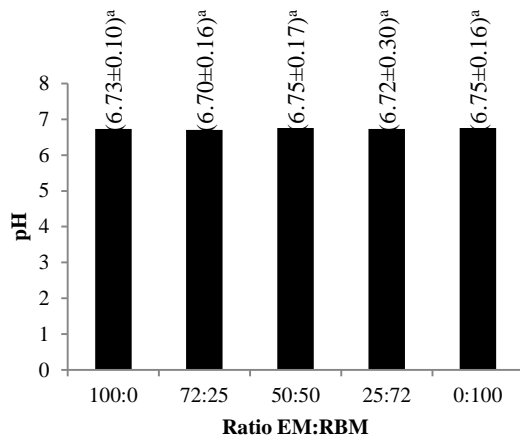


Figure 6. Ratio EM : RBM towards pH

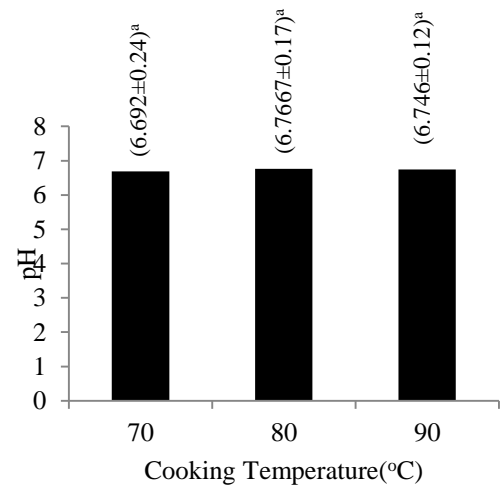


Figure 7. Cooking temperature towards pH

Effect Ratio Edamame Milk to Red Bean Milk and Cooking Temperature to Viscosity of Edamame and Red Bean Milk

The statistical analysis result showed that the ratio EM to RBM and cooking temperature gave a significant effect ($p < 0.05$). There was a significant difference on cooking temperature towards viscosity, shown in Fig 9. The cooking temperature at 70°C (67.120 ± 6.3803) gives higher viscosity compared to 90°C (61.033 ± 7.9289). This result was in accordance to Shurtleff and Aoyagi [1] in which stated that if the cooking temperature increase, could decrease the viscosity.

Determination of Type and Concentration of Stabilizer towards Stability of Edamame and Red Bean Milk

Three types of stabilizers CMC, xanthan gum (XG), and guar gum (GG) were used independently to three selected formulations from research stage 1. CMC were added by 0.1%, 0.2%, and 0.3%, while XG and GG were added by 0.025%, 0.05%, and 0.1%. Finally, XG was selected to be used in formulation with different ratio of edamame milk and red bean milk. Those are 100: 0, 75:25, and 50:50 with XG addition by 0.025% , 0.05%, and 0.1%. XG provided good solubility over the temperature range freezing to near boiling with excellent thermal stability [6]. This statement supported the production of the beverage at 90 °C as an optimum cooking temperature.

Determination of the Most Preferred Formulation by Hedonic Test

The beverages that had already stable were subjected to hedonic test. There are 5 different parameters including color, aroma, taste, mouthfeel, and overall acceptance. 80 panelist were given by three formulations with optimum stability. Those are EM:RBM 100: 0; 75:25; and 50:50 with XG 0.025%, 0.05%, and 0.1%. According to the result, the different formulations

gave a significant effect toward the color preference of the functional beverage. Based on the result obtained, the beverage with ratio EM : RBM of 75:25 with XG addition by 0.05% is determined as the most preferred formulation. The selection is also based on the objective to utilization red bean regarding processed food or functional food as an innovation in functional food development.

Determination of the Preferred Formulation of Functional Beverage

Determination of the best formulation of functional beverage based on several parameters: protein, dietary fiber, pH, total solids, and hedonic test. From the research, the best formulation was ratio EM to RBM of 75:25 with 90 °C as optimum cooking temperature and XG added by 0.05 %. This formulation contain 4.46 % dietary fiber and is categorized as "source of dietary fiber" since the dietary fiber was more than 3 % and adequate daily intake to 17.84 %.

According to CAC [10], "source of dietary fiber" category means 3 grams per 100 ml and 10-19 % of daily intake. Table 8 showed the ratio between the EM and RBM functional beverage in the research with the soy milk quality standard (SNI 01-3830-1995). The purpose of these comparisons is to determine the RBM and EM functional drink made whether compliance with the standards. The results of all formulations meet the soy milk quality standard (SNI 01-3830-1995) on the total solids, protein content, and pH. The further analysis for the preferred formulation is proximate analysis, including water, protein, ash, fat, and carbohydrate content. The result of proximate analysis in Table 9 shows the results of the best proximate analysis formulations. Protein levels and fat in the most preferred functional beverage in accordance with the soy milk quality requirements (SNI 01-3830-1995) stating that the minimum protein content 2 % and minimum fat content 1 % [5].

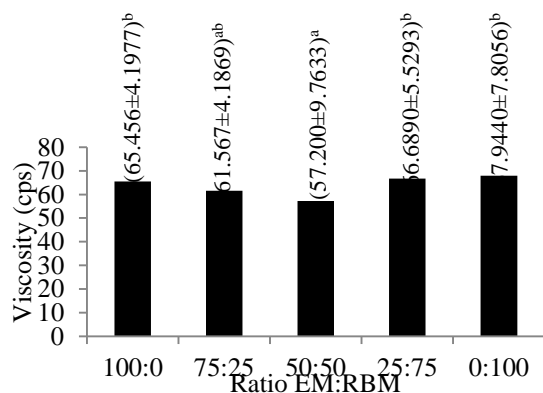


Figure 8. Ratio EM:RBM towards Viscosity (cps)

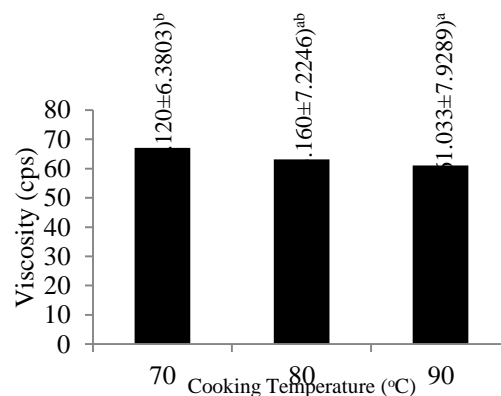


Figure 9. Cooking Temp. towards Viscosity (cps)

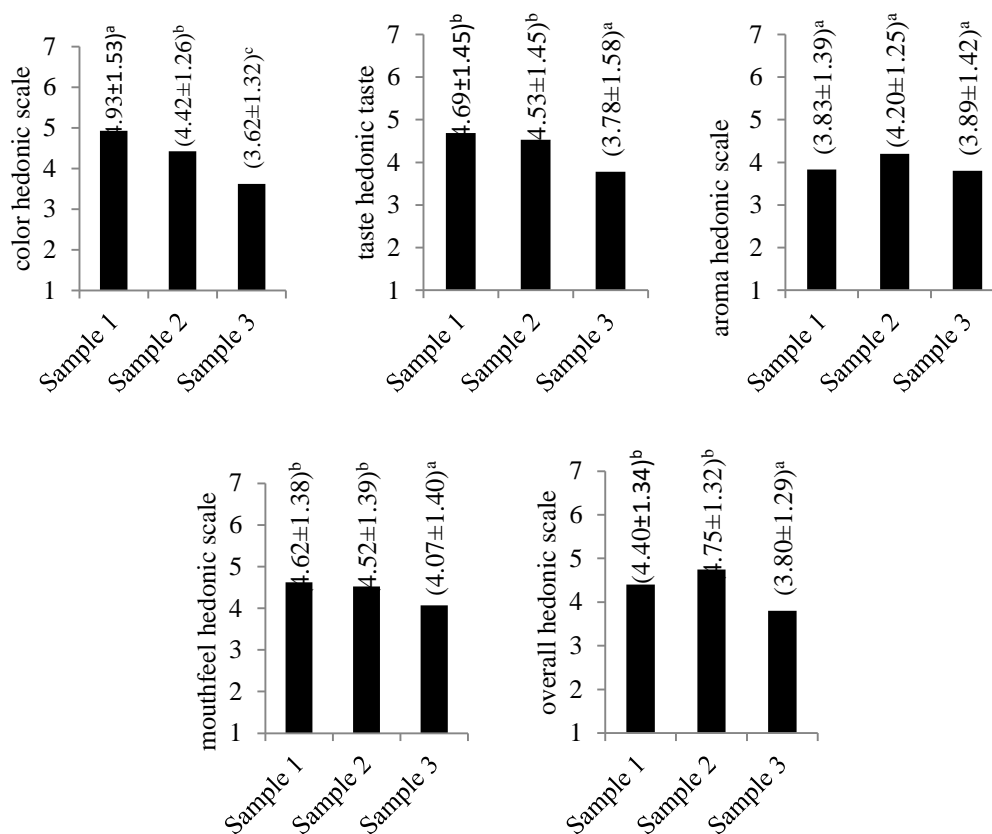


Figure 10. The result of hedonic test. Note: Hedonic scale (1=extremely dislike, 7=extremely like.) Sample (1 = 100:0, 90°C, 0.025 % XG ; 2 = 75 : 25, 90°C, 0.050 % XG ; 3 = 50 : 50, 90 °C, 0.100 % XG)

Table 8. Comparison the formulation with SNI 01-3830-1995

Parameter	SNI Soy Milk	F1	F2	F3
Protein (%)	Min.2.00	3.60	3.20	3.43
Dietary Fiber (%)	-	5.11	4.46	4.34
pH	6.50-7.0	6.78	6.51	6.60
Total Solid (%)	Min.11.50	12.24	11.56	12.01

Formulation 1 (F1) = 100:0, 90°C, 0.025% XG

Formulation 2 (F2) = 75:25, 90°C, 0.050% XG

Formulation 3 (F3) = 50:50, 90°C, 0.100% XG

Table 9. Proximate analysis of the most preferred formulation

Parameter	Result
Water (%)	88.46 ± 0.04
Protein(%)	2.58 ± 0.13
Fat(%)	2.51 ± 0.49
Ash(%)	0.28 ± 0.01
Carbohydrate(%)	6.16 ± 0.59

Observation on Shelf Life Test

Observations on shelf life test were carried out on a best EM and RBM functional beverage up to pH of less than 6.50. After storage in refrigerator for 14 days the pH declined. On day 1, pH 6.91 declined up to pH 6.54 on day 14, then on 15th day pH become 6.45. Consequently, it could be concluded that shelf life of EM and RBM functional drink was 14 days with good aroma and taste.

CONCLUSION

Beverage made from edamame bean and red beans contained dietary fiber 4.46 % and adequate daily intake 17.84 %, which could be categorized as a “dietary fiber source” drink. Accordingly, it also could be categorized as functional drink. From the first stage of research, protein of EM and RBM functional drinks obtained between 1.74-3.60 %, the average pH 6.75, the range of viscosity 48.8-70.8 cps, while the total solids varied from 7.95 % to 17.91 %, as well as the optimum cooking temperature was 90 °C. Second stage of the research obtained that Xanthan Gum was determined as appropriate stabilizer. Selection of RBM and EM functional beverage of test preferences was ratio of EM 75 to RBM 25 with 0.05 % stabilizer addition. The shelf life of the drink in this research was 14 days. To improve the aroma, the drink could be added by vanilla flavor. In addition, the beans can be soaked with hot water before it is milled in order to remove the lipooxygenase enzymes that contribute the unpleasant aroma.

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