ELDERLY INSTANT PORRIDGE FROM NUTS FLOUR COMPOSITE USING TRAY DRIER METHOD

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Abstract

Elderly need foods that is functional, nutritious and easy to digest to meet nutritional adequacy in order to maintain health and reduce the impact of decreased anatomical and physiological function on the digestive system. This study aims to obtain the right percentage of composite flour and drying temperature of post-instantization flour for making instant porridge that can meet the nutritional needs of the elderly. The experimental design used a factorial Completely Randomized Design (CRD) with the first factor being the percentage of nuts flour composite (soy beans, red beans, green beans) at three levels, namely A1 (21%:15%:24%), A2 (18%:18% :24%), and A3 (15%:21%:24), while the second factor is the drying temperature using two levels, namely B1 (60◦C) and B2 (70◦C). Data were analyzed using variance (ANOVA) and Duncan's test on SPSS 20. The result of this research produced the best instant porridge, namely A1B1 treatment with 4.24% moisture content, 19.5% protein, 2.98% fat, 4.59 ash, carbohydrates 68.6%, total energy 379.5 Kcal/100 g, dietary fiber 14.1% and calcium 518.69 mg/100 g, and kamba density is 0.67 g/mL and water absorption is 4, 00g/. The results of the hedonic test showed that 96.7% of the elderly said they liked color, 60.0% really liked aroma, 93.3% liked taste, and 70% liked texture. Overall, this instant porridge is preferred by the elderly and can meet the nutritional needs of the elderly. The limitations of this research is that this porridge cannot be consumed by people who are allergenic to nuts. This instant porridge for the elderly contains sufficient nutrients to meet the nutritional needs of the elderly, so it has the opportunity to be used as a staple food for the elderly in addition to flavored consumption.

Keywords: bean composite flour, elderly, instant porridge, tray drier

I. INTRODUCTION

The age of the elderly is limited to two categories, namely old age between 60-74 and old age above 75 years [1]. In 2017 the number of elderly people in Indonesia reached 23.4 million people and increased to 24.49 million people in 2018, This increase in the number of elderly is proof of the success of development in the health sector [2]. Health has become a basic need for the lives of the elderly, but aging causes a decrease in the anatomical and physiological functions of the body which causes health problems such as the digestive system [3]. A disturbed digestive system can result in a lack of adequate daily nutritional intake. Lack of certain nutritional intake in the elderly causes various diseases, including sarcopenia and osteoporosis.

Sarcopenia is a change in muscle function or muscle weakness accompanied by reduced muscle mass [4]. Insufficient protein consumption can cause muscle mass loss in the elderly [5]. Another health problem that can attack the elderly is osteoporosis. Osteoporosis is a decrease in bone density which can be caused by a lack of calcium consumption [6]. Elderly people need food that is easy to digest and rich in nutrients so that they can meet their nutritional needs. Instant porridge made from a mixture of soybeans, red beans and green beans can be used as an alternative solution to help meet the nutritional needs of the elderly.

Instant porridge is porridge that has undergone previous processing such as instantization so that it does not require a cooking process to serve [7]. Soybeans *(Glycine max L.)* is a type of legume with the highest protein content compared to other beans, namely around 40% protein [8]. Red beans (*Beanolus vulgaris L*) is a good source of minerals, especially because it contains more calcium than other nuts, namely around 260 mg/100 gr [9]. Green beans (*Vigna radiata L.)* has the highest carbohydrate content compared to other types of nuts, namely around 70.7 gr/100 gr [10].

Instant porridge processing cannot be separated from the drying process. The drying method that can be used in making instant porridge is using tray drier. Tray drying (tray drier) can be used to dry food in the form of paste or lumpy solids. The temperature and drying time factors are considered very important and determine the quality of the resulting product [11]. Therefore, it is very important to carry out research on "Elderly Instant Porridge From Nuts Flour Composite Using Tray Drier Method". Most instant porridge products on the market are in the form of MP-ASI for toddlers, while there are not many instant porridges for the needs of the elderly. This research aims: (1) to formulate instant porridge made from red bean instant flour composite (*Arachis hypogae L*), soybeans (*Glycine max*), and green beans (*Vigna radiata L.*) which can meet the nutritional needs of the elderly and (2) know the right drying temperature for making instant porridge

II. METHODOLOGY

Time and Place of Research

This research was carried out from November 2019 to January 2020 at the Chemistry Laboratory of Djuanda University, the PAU Laboratory of the Bogor Agricultural Institute, and the Saraswati Bogor Laboratory.

Materials and tools

The materials used in this research consist of main materials, supporting materials and chemicals. The main ingredients used are red bean flour, soybean flour and green bean flour. The supporting materials used are refined sugar, skim milk, vanilla flavor and salt and the chemicals used for analysis are distilled water, Luff's solution, sulfuric acid (H_2SO_4), vanadatmolybdate reagent, Na-phosphate buffer, boric acid, borax, NaOH, dinitrosalicylate, standard maltose solution, HCl,

The equipment used in the research consisted of equipment for making instant porridge such as basins, tray drier type AM-TD24 capacity 12 shelves which is produced by PT. Khalifah Niag Lantabura, Yogyakarta, flouring tools in the form of a Panasonic blender, and a 60 mesh sieve purchased at the Ciawi Bogor market, tools for chemical and physical tests such as B150-I Electric Blast Oven produced by China, HTF 17-5 carbolite type furnace originating from the United States, and 800-1 centrifuge electric which is produced by China.

Instant porridge formulation

Making this instant porridge begins with the instantization process of three peanut flour, weighing the ingredients and mixing (dry mixing). The formulation of instant porridge for the elderly can be seen in Table 1 and its preparation can be seen in Figure 1.
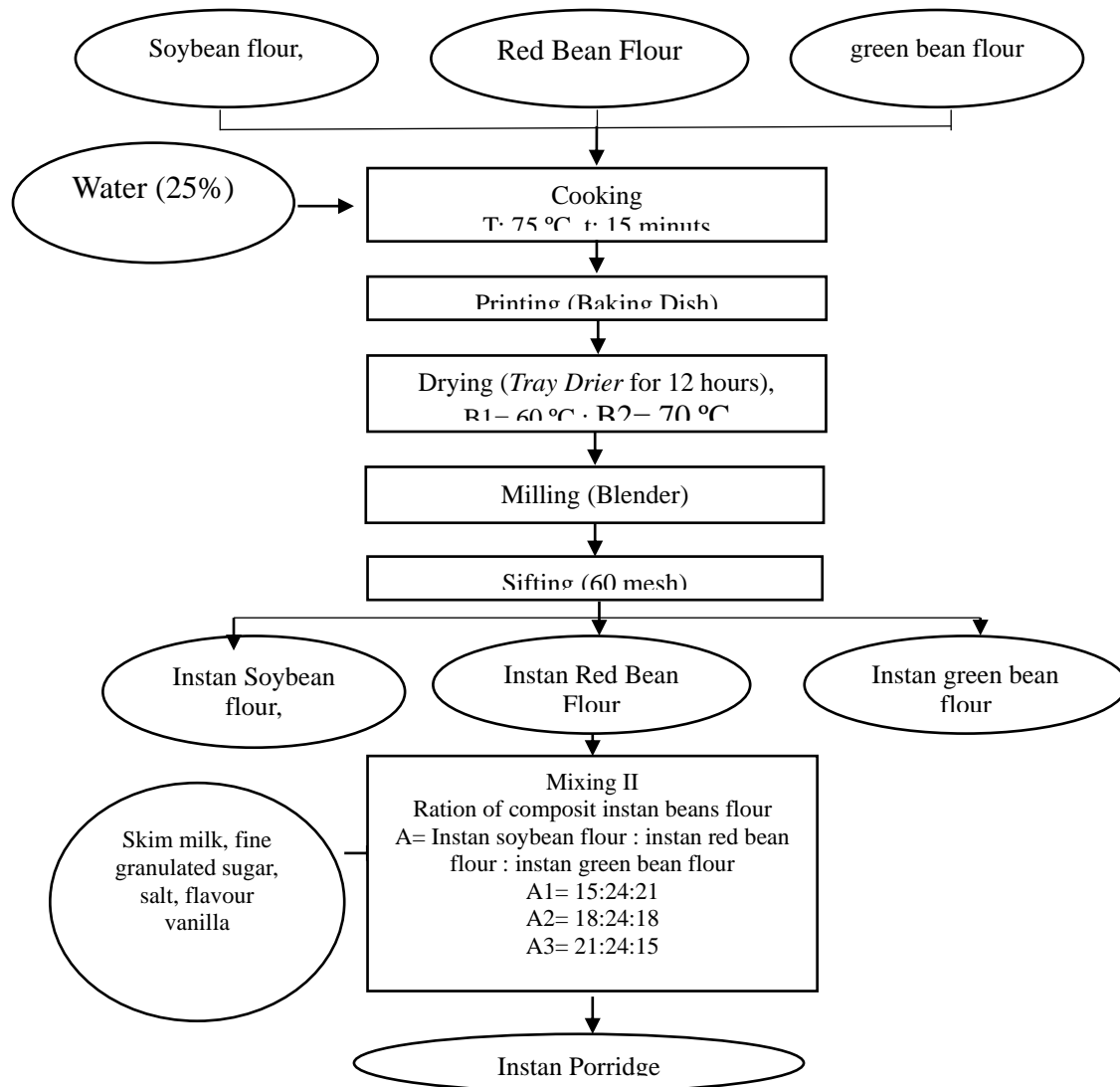
Figure 1 Flow Diagram of The Instant Porridge Making Process
Source: Modification of Tampubolon (2014)

Table 1 Formulation For Making Slurry

Food stuffs	Formula (%)		
	A1	A2	A3
Instant Soybean Flour	21	18	15
Red Bean Instant Flour	15	18	21
Instant Green Bean Flour	24	24	24
Fine granulated sugar	19,8	19,8	19,8
Skim Milk	20	20	20
Flavour Vanilla	0,1	0,1	0,1
Salt	0,1	0,1	0,1

Source: Modification of Yustiyani (2013) and Farida*et al.* (2015)

Product Analysis

Instant porridge products that undergo physical and chemical analysis to obtain selected products. The physical analysis carried out was the measurement of kamba density [12] and water absorption capacity [13]. The chemical analysis carried out is in the form of analysis of carbohydrate, protein, fat, water, ash and total energy [14]. Selected products are determined based on the best results of chemical analysis and physical analysis. The selected instant porridge was then tested for calcium levels, dietary fiber, and a hedonic test on a scale (1-7) on aroma, color, texture and taste parameters carried out on 30 elderly people as untrained panelists [15].

Experimental design

This research used a factorial Completely Randomized Design with the first factor, namely the formulation of instant soybean flour: instant red bean flour: instant green bean flour using three treatment levels, namely A1 (21%:15%:24%), A2 (18%:18 %:24%), and A3 (15%:21%:24%) and the second factor is the use of drying temperature with two treatment levels, namely B1 (60◦C) dan B2 (70◦C) as well as two repetitions for each test.

Data analysis

Data analysis used the SPSS 20 program. The results of the chemical and physical properties of instant porridge were analyzed using variance analysis (ANOVA). If the ANOVA results have a significant effect ($p<0.05$), then continue with Duncan's analysis at the 95% confidence level to find out in detail the data that is significantly different. The hedonic test results were analyzed using a frequency distribution to determine the percentage of panelists' preferences.

III. RESULTS AND DISCUSSION

Elderly Instant Porridge

Making instant porridge for the elderly begins with the pregelatinization process of each beans flour. Pregelatinization is a method of physical instantization by cooking starch in water until it is completely gelatinized to form a paste and then dried [7]. Gelatinization is heating a mixture of starch granules and water until the granules develop which is characterized by the formation of a thick, paste-shaped liquid [16].

The temperature levels used in drying instant porridge are based on research by Setyo (2003), which states that drying ingredients is below a temperature of 45◦C still provides growth opportunities for pathogenic microorganisms and when drying above 75◦C can cause mass transfer of water and heat, causing damage to the physical and chemical structure of materials. Based on this description, the drying temperature that is considered appropriate to maintain the quality of the material is between $45^OC – 75^OC$. Therefore, in this study the researchers used a temperature of 60^OC and 70^OC for drying slurry in the instantization process [17].

This instant porridge is also composed of several additional ingredients to enhance the taste such as skim milk, powdered sugar, salt and vanilla flavour. In general, the sensory properties of brewed elderly porridge are brownish ash in color, sweet in taste, typical nutty aroma, and slightly rough in texture.

Physical Properties of Instant Porridge for the Elderly

1. Kamba Density

Kamba density is a value that shows the number of empty cavities (*void space)* between material particles, the greater the Kamba density value of a material, the fewer the number of empty cavities in the material [18]. The average value of instant porridge kamba density for the elderly can be seen in Table 2.

Table 2 Average Value of Instant Porridge Kamba Density For The Elderly

Temperature	Formulation			Rate-rate
	A1	A2	A3	
B1	0,669[a]	0,670[a]	0,688[a]	0,676[x]
B2	0,687[a]	0,732[a]	0,731[a]	0,717[y]
Rate-rate	0,678[p]	0,701[p]	0,709[p]	

Note: different letter notations indicate further test results are significantly different at $\alpha=0.05$

The results of analysis of variance for the flour formulation treatment and the interaction between the formulation and drying temperature did not have a significant effect on the kamba density of elderly instant porridge (p>0.05). Meanwhile, drying temperature had a significant effect on the kamba density of elderly instant porridge (p<0.05). Based on Duncan's further test results, the instant porridge was dried at a temperature of 60◦C (B1) has a lower kamba density compared to a temperature of 70◦C (B2) and its value are significantly different. This means instant porridge at 70◦C has fewer voids or low porosity. This is in accordance with Suryana's statement in his research that the greater the kamba density value of a food ingredient causes its porosity to be smaller and its water absorption capacity to be lower [19].

The kamba density value of powdered products ranges between 0.3-0.8 g/m) [12]. This elderly instant porridge has a kamba density of 0.669-0.732 g/mL and is considered to still meet existing standards. Each food product has a different kamba density and this is influenced, among other things, by the characteristics of the ingredients that make it up [20]. This elderly porridge is made from the main ingredient of beans flour. The density of soybean flour kamba is 0.39 g/mL (Astawan and Hazmi, 2016) [21], the density of red bean flour kamba is 0.58 g/mL (Ruben*et al*. 2016) [22], and the density of green bean flour is 0.7 g/mL [23]. Green bean flour and red bean flour contribute higher kamba density values to elderly instant porridge than soybean flour, so that porridge with the highest percentage of red bean and green bean flour has a greater kamba density value.

2. Water Absorption Capacity

Absorption capacity is the ability of a material to attract or absorb water around it so that it binds to the material particles or remains in the pores between particles [24]. The average value of the water absorption capacity of instant porridge for the elderly can be seen in Table 3.

Table 3 Average Value of Water Absorption Capacity of Instant Porridge For The Elderly

Temperature	Formulation			Rate-rate
	A1	A2	A3	
B1	4,00[a]	4,20[a]	3,75[a]	3,98[x]
B2	3,60[a]	3,25[a]	3,05[a]	3,30[x]
Rate-rate	3,80[p]	3,73[p]	3,40[p]	

Note: different letter notations indicate further test results are significantly different at $\alpha=0.05$

Based on the results of the variance test, it showed that the flour formulation treatment, drying temperature, and the interaction of formulation and temperature did not significantly influence the water absorption capacity of elderly instant porridge (p>0.05). The water absorption capacity of commercial instant porridge ranges from 3.60-6.20 g/g [24]. The water absorption value of instant porridge for the elderly ranges from 3.05-4.20 g/g and is considered to still meet existing standards.

Chemical Properties of Instant Porridge for the Elderly

1. Protein Rate

Proteins are amino acids that link together to form peptide chains [25]. The average value of instant porridge protein content for the elderly can be seen in Table 4.

Table 4 Average Value Of Instant Porridge For The Elderly

Temperature	Formulation			Rate-rate
	A1	A2	A3	
B1	19,5[a]	18,9[b]	17,5[c]	18,7[x]
B2	18,7[b]	18,6[c]	18,1[c]	18,5[x]
Rate-rate	19,1[p]	18,8[p]	17,8[q]	

Note: different letter notations indicate further test results are significantly different at α=0.05

The results of analysis of variance showed that flour formulation and the interaction of formulation and temperature had a significant effect on the protein content of elderly instant porridge (p<0.05), while drying temperature had no significant effect (p>0.05). The results of further analysis of the Duncan test showed that the A3 formulation treatment was significantly different from the A1 and A2 formulations. Apart from that, the interaction factors between formulation and sample treatment temperature were significantly different from each other.

The protein content of instant porridge is influenced by the protein content of the raw materials that make it up. The protein content of soybean flour is 35.9%, red bean flour 22.1% [26], while the protein content of green bean flour is 4.5% [27]. Flour Soybeans have the highest protein content of the other flours used, so instant porridge with the highest percentage of soybean flour (A1), namely 21%, has the highest protein content, namely 19.5%. The same thing was also found in research by Lumentut which explained that the use of 20% soy flour contained 15.37% higher protein compared to the use of 0% soy flour which had a protein content of 10.91% in instant porridge mixed with pregelatinized purple cassava tuber flour. and soybeans [24]

2. Water Rate

The average value of instant porridge water content for the elderly can be seen in Table 5.

Table 5 Average Value of Instant Porridge Water Content For The Elderly

Temperature	Formulation			Rate-rate
	A1	A2	A3	
B1	4,24[a]	4,17[a]	4,32[a]	4,24[x]
B2	4,21[a]	4,05[a]	3,89[a]	4,05[y]
Rate-rate	4,23[p]	4,11[p]	4,10[p]	

Note: different letter notations indicate further test results are significantly different at α=0.05

The results of the analysis of variance showed that the flour formulation and the interaction of the two factors had no significant effect on the water content of instant porridge (p>0.05), while the drying temperature had a significant effect on the water content of the porridge (p<0.05). Elderly instant porridge from all treatments had water content ranging from 3.89-4.32%. Slurry with drying temperature 70∘C has a lower water content and is significantly different from instant porridge at a drying temperature of 60∘C. This occurs because the higher the drying temperature causes the lower the water content due to evaporation. The same thing was also conveyed by Diza*et al,* who stated that the water content of instant rice porridge and instant black sticky rice porridge as a result of their research had a lower water content as the drying time was longer and the temperature used was higher [28]

3. Ash Rate

The average ash content value of instant porridge for the elderly can be seen in Table 6.

Table 6 Average Value of Ash Content For Elderly Instant Porridge

Temperature	Formulation			Rate-rate
	A1	A2	A3	
B1	4,59[a]	4,52[a]	4,48[a]	4,53[x]
B2	4,55[a]	4,51[a]	4,53[a]	4,52[x]
Rate-rate	4,57[p]	4,51[p]	4,50[p]	

Note: different letter notations indicate further test results are significantly different at $\alpha=0.05$

The results of variance analysis showed that flour formulation, drying temperature, and the interaction of formulation and temperature had no significant effect on the ash content of elderly instant porridge (p>0.05). The ash content of instant porridge for all treatments ranged from 4.48-4.59%. The ash content of this research is higher than Anandito's research who made instant porridge from white millet flour and red bean flour which had an ash content of 4.12% [29]. The high ash content of this instant porridge for the elderly is thought to be due to the ash content in each beans that was used like on soybean flour (1.99%) [21] and green bean flour (2.71%) [30], higher than millet flour (1.80%) [31].

4. Fat Rate

The average value of instant porridge fat content for the elderly can be seen in Table 7.

Table 7 Average Value of Fat Content of Instant Porridge For The Elderly

Temperature	Formulation			Rate-rate
	A1	A2	A3	
B1	2,98[c]	4,08[a]	2,56[e]	3,21[y]
B2	3,49[b]	3,18[b]	2,13[e]	2,93[x]
Rate-rate	3,23[q]	3,63[p]	3,35[r]	

Note: different letter notations indicate further test results are significantly different at $\alpha=0.05$

Based on the results of analysis of variance, it shows that flour formulation, drying temperature, and the interaction of formulation and temperature have a significant effect on the fat content of elderly instant porridge (p<0.05). Duncan's test results showed that each level of flour formulation, drying temperature, and the interaction of formulation with temperature were significantly different from each other on the fat content of elderly instant porridge.

The fat content of instant porridge for the elderly ranges from 2.13-4.08%. The fat content of an ingredient can come from each ingredient used for its production [24]. The fat content of soybean flour and red bean flour is 18.1% and 1.1% respectively [26], and the fat content of green bean flour is 1% [27]. When referring to the fat content of each bean flour, A2 formulation flour has a total fat of 8%, A1 formulation 7%, and the lowest is A3 formulation 5.3%. For this reason, the highest average fat content of instant porridge for elderly people was obtained from the A2 flour formulation, namely 3.63%. In elderly instant porridge with a drying temperature of 70◦C has a lower fat content than a temperature of 60◦C. This is thought to be because the fat content in the material is oxidized so that the level decreases. According to Derlean (2009) [32], heating will cause damage to the oil, because the oil will undergo an oxidation process.

5. Carbohydrate Rate

The carbohydrate content of instant porridge for the elderly can be seen in Table 8.

Table 8 Average Value of Instant Porridge Carbohydrate Content For The Elderly

Temperature	Formulation			Rate-rate
	A1	A2	A3	
B1	2.98^c	4,08^a	2,56^e	3,21^y
B2	3.49^b	3,18^b	2,13^e	2.93^x
Rate-rate	3,23^q	3,63^p	3,35^r	

Note: Different letter notations indicate significantly different values at α=0.05

The results of variance analysis showed that flour formulation, drying temperature, and interaction of formulation and temperature had a significant effect on the carbohydrate content of instant porridge for the elderly (p<0.05). Duncan's test results showed that the carbohydrate content of formulation A3 was significantly different from formulations A1 and A2. Carbohydrate content of instant porridge for the elderly with a drying temperature of 60∘C is higher and significantly different from slurry dried at 70∘C. This occurs because the higher drying temperature can cause a decrease in water content due to evaporation and breakdown of glycosidic bonds in complex carbohydrates resulting in a decrease in carbohydrate content and an increase in the percentage of simple sugar content [33]. The carbohydrate content of soy flour is 29.9%, red bean flour 56.2% [26], and green bean flour 83.5% [27]. If calculations were carried out based on the total carbohydrate content of each flour, the result was that the highest total carbohydrates were found in the A3 flour formulation 61.8%, A2 60.6%, and A1 59.5%.

6. Total Energy

Carbohydrates contribute 55-67% of total calories, fat contributes 20-30% of total calories, and protein contributes 13-15% of total calories/day) [34]. The average total energy value of instant porridge for the elderly can be seen in Table 9.

Table 9 Average Total Energy Value of Instant Porridge For The Elderly

Temperature	Formulation			Rate-rate
	A1	A2	A3	
B1	379,6^e	385,6^a	377,6^e	380,9^x
B2	382,5^b	381,7^c	377,0^e	380,4^x
Rate-rate	381,0^q	383,7^p	377,3^r	

Note: Different letter notations indicate significantly different values at α=0.05

The results of analysis of variance showed that flour formulation and the interaction of flour and temperature had a significant effect on the total energy of instant porridge for the elderly (p<0.05), while drying temperature had no significant effect on the total energy of instant porridge for the elderly (p>0.05). The results of further analysis of the Duncan test showed that the total energy of the slurry for all treatments was significantly different.

Instant porridge for all treatments has a higher energy content (380.9 – 380.4 38 kcal/100 gr) compared to instant porridge from Anandito's research which makes instant porridge from red bean flour and white millet flour (205.38 kcal/100 gr) [29]. This is thought to occur because the total calories of soybean flour are 331 kcal and red bean flour is 314 kcal [32], green bean flour is 364 kcal [27], and white millet has a total calorie of 334.0 kcal [35]. When referring to the calories of each flour, the total calories of millet and red bean flour formulations are 230.3 kcal and lower than the total calories of bean flour in formulation A1, namely 339.95 kcal, A2 339.1 kcal, and A3 338. 25 kcal.

Determination of Selected Products

Determination of the selected instant porridge is assessed based on the results of physical property analysis which is in the normal or standard category and based on the results of chemical analysis, namely the highest protein content. Instant porridge which has good physical properties and the highest protein content is sample A1B1 with a formulation of 21% instant soybean flour + 15% instant red bean flour + 24% instant green bean flour and a drying temperature of 60∘C. The values of the chemical and physical properties of selected elderly instant porridge can be seen in Table 10.

Table 10 Average Results of Physical Properties And Chemical Properties of Selected Instant Porridge

Parameter	Much
Kamba Density	0.67 (g/mL)
Water Absorption Capacity	4.00 (g/g)
Carbohydrate Rate	68,6 (%)
as much protein	19,5 (%)
Fat Rate	2,98 (%)
Water Rate	4,24 (%)
Ash Rate	4,59 (%)
Total Energy	379.5 (Kcal/100 g)

According to data from the Ministry of Health (2013), elderly women (50-64 years) need 1900 kcal/day of calories and elderly men (50-64 years) need 2325 kcal/day [36]. 100 g of selected instant porridge contains 379.5 energy. If an elderly person consumes 100 g of instant porridge in one meal, this can provide an energy intake of 19.98% for elderly women and 16.32% for elderly men. This selected instant porridge weighing 100 g contributes to the daily nutritional adequacy of the elderly, namely contributing to the fulfillment of carbohydrates by 24.1% of the RDA of elderly women and 19.7% of the RDA of elderly men, as well as contributing to the fat requirements of 5.6% of the RDA of elderly women and 4.6% RDA of elderly men. This instant porridge contributes to the protein requirements of 34.3% of the RDA of elderly women and 30.1% of the RDA of elderly men.

Calcium and Food Fiber Content of Selected Products

1. Calcium Levels

This elderly instant porridge has a calcium level of 518.69 mg/100g. According to BPOM (2016) food ingredients that contribute more than 15% ALG (Nutrition Label Reference) minerals can be claimed as food sources of minerals, and if they exceed 30% ALG they can be claimed as high in minerals [37]. The selected porridge product (A1B1) contributes calcium to 48.2% of ALG for general consumer categories such as the elderly so it can be claimed as a high calcium food. In addition, this selected diamond porridge calcium contributes 51.8% of the calcium needs of elderly women and men.

2. Food Fiber Content

Instant porridge for the elderly in the selected treatment contains a dietary fiber content of 14.09%. According to BPOM (2016) an ingredient can be claimed as a source of dietary fiber if it contains more than 3 g/100 g of dietary fiber and can be claimed as a food high in or rich in dietary fiber if it contains more than 6 g/100 g of dietary fiber [37]. Based on test results, the selected porridge product (A1B1) contains 14.1 g of instant porridge/100 g of dietary fiber so it can be claimed as a food high/rich in dietary fiber. This instant porridge food fiber contributes 42.7% of the fiber needs of elderly men and 50.3% of the fiber needs of elderly women.

3. Organoleptic Value

Organoleptic assessment was carried out using hedonic tests*scoring* (1-7) with descriptions (1) Like it very much; (2) Like it very much; (3) Like; (4) Medium; (5) Dislike; (6) Dislike very much: and (7) Dislike very much. The organoleptic test panelists are untrained panelists consisting of 30 elderly

people aged over 50 years who live around Limbangan Village, Sukaraja District, Sukabumi. The average value of elderly people's preference for instant porridge can be seen in Table 11.

Table 11 Average Value of Elderly People's Preference For Instant Porridge

Parameter	Average value	Information	Percentage
Color	2,97	Criticism	96,7%
Aroma	2,57	Very like	60,0%
Feel	2,93	Criticism	93,3%
Texture	3,43	Criticism	70,0%

The results of the hedonic test for instant porridge for the elderly showed that 96.7% of the panelists liked the color of the instant porridge for the elderly, 60.0% of the panelists really liked the aroma, 93.3% of the panelists liked the taste and 70.0% liked the texture of the instant porridge for the elderly.

IV. CONCLUSIONS AND NEWNESS

The selected instant porridge is porridge made with a formulation of 21% instant soybean flour + 15% instant red bean flour + 24% instant green bean flour and a drying temperature of 60∘C. This instant porridge for the elderly contains sufficient nutrients to meet the nutritional needs of the elderly, so it has the opportunity to be used as a staple food for the elderly in addition to flavored consumption, etc.

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