Proximate analysis of soybean and red beans cookies according to the Indonesian National Standard

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Abstract. Proximate analysis is a chemical analysis method to identify the food content of an ingredient. The proximate analysis component (protein, ash, fat, water and carbohydrate) correlate with the nutrition value of food. Many kinds of cookies were sold in the market but the data of proximate analysis results related with food quality is scarce. Three samples of cookies (one sample of soybean cookies and two of red bean cookies) that are available in Indonesian market were assessed in this study. Soybean cookie (sample no.387) was in accordance with Indonesian National Standard (INS) in terms of ash content and fat content. Red bean cookies (samples no. 388 and 389) met the INS requirements of protein and fat content. Whereas, all cookies samples were not INS compliant in terms of moisture content and carbohydrate levels (maximum 5% and minimum 70%, respectively).

1. Introduction
Cookies are popular ready to eat snack foods and widely consumed by all age groups especially by children around the world due to their simple manufacturing process, long shelf life and potential for containing high nutrient components [1]. Cookies are made from different flours that are characterized by a formula with high in sugar, shortenings and relatively low in water. Cookies that available in the market are made from white flour, which is nutritionally lower than whole wheat meal [2]. Cookies type of biscuit that taste sweet and small in shape. This is made of soft flour with high fat content, crispy, and has solid texture [3]. Based on the requirements for the quality of cookies according to INS, in 100 g contribute a minimum energy intake of 400 kcal, 9% protein, and 30% carbohydrates. As a food that is liked by most people of various ages, cookies needed to be enhanced in terms of nutritional value and to be diversified.

Cookies quality requirements that apply in Indonesia are based on the Indonesian National Standard (INS 01-2973-1992), as in the following table:

| Requirement Criteria       | Classification |
|----------------------------|----------------|
| Water (%)                  | Maximum 5     |
| Protein (%)                | Minimum 9     |
| Fat (%)                    | Minimum 9.5   |
| Carbohydrate (%)           | Minimum 70    |
| Ash (%)                    | Maximum 1.6   |
| Harmful metal              | Negative      |
| Crude Fiber (%)            | Maximum 0.5   |
| Calories (Cal/100 g)       | Maximum 400   |
| Smell and flavor           | Normal        |
| Color                      | Normal        |

Table 1. INS Requirement for Cookie Products (INS 01-2973-1992)
Soya is a good protein source (35-40%). Soybean seed is the richest of all plant products eaten worldwide [5]. Soya is a widely-used, cheap, and nutritious protein source. Its protein content (40%) is higher and more cost-effective than that of beef (19%), chicken (20%), fish (18%), and groundnut (23%) [6]. Soybean is also rich in minerals and vitamins such as iron, zinc, copper, thiamine, riboflavin, niacin and pantothenic acid [7].

Red beans are the type of beans that have the highest carbohydrate content, content protein that is equivalent to green beans and has fiber levels that are equivalent to green beans, soybeans and peanuts. Fiber content at red beans are much higher than rice, corn, sorghum and wheat. Compared to the source the superior animal protein of red beans is cholesterol free, so it is safe for consumption by all community groups from various age groups. Red bean protein can also be used for reduce levels of LDL cholesterol which is bad for human health, and increase levels HDL cholesterol which is good for human health [8].

In processing food including soy and red bean cookies, quality control is a requirement that must be achieved. The food manufacturing companies need to ensure that their products meet requirements and safety aspects of the end product before released to the market. The determination of food quality and nutritional value can be carried on by analysis of macronutrient levels. Macronutrient analysis is conducted by proximate analysis, which is an analysis to determine the main components of food, including total ash content, total water, total fat, total protein and total carbohydrates. Therefore, proximate analysis related with food quality and important to be performed. In addition, proximate analysis is generally inexpensive and relatively easy to do [9].

2. Research Methods

2.1. Materials

The ingredients used in this analysis are sample cookies with code 387 (soybean cookies), code 388 and code 389 (red bean cookies), aquadest, NaOH 50%, NaOH 0.1 N, HCl 0.1 N, Methyl Red indicator and Benzene Petroleum.

2.2. Proximate Analysis (INS 01-2891-1992)

2.2.1. Total ash content

Measurement of total ash content was carried out by drying ash method. 3 g of each samples were placed into a pre-weighed porcelain crucible, then ignited in a furnace at 550ºC until burned completely. The crucible was cooled at room temperature in a desiccator and then weighed. The overall ash content is equal to the ash weight divided by the initial sample weight multiplied by 100%.

2.2.2. Total water content

Total water content analysis is performed using the thermogravimetric test. 2 g of each sample was put into a pre-weighted porcelain dish and then dried for 3 hours in an oven at 105ºC. It is cooled in the desiccator and measured the weight. The measurement of the humidity content is obtained by dividing the sample weight before drying and by multiplying the weight loss after drying by 100%.

2.2.3. Total fat content (Saxhletation)

Measurement of total fat content is done by the Soxhletation method. 2 g of sample was put into filter paper lined with cotton. Filter paper containing the sample is dried in an oven at a temperature of no more than 80ºC, ± 1 hour and put into a Soxhlet device that has been connected with a fat bottom flask. After that, it is extracted with benzene petroleum solvent for about 6 hours. Benzene petroleum is distilled and the fat extract is dried in an oven at 105ºC, then cooled and weighed. Calculation of fat content is done by dividing fat weight and sample weight then multiplied by 100%.

2.2.4. Total protein level

Measurement of total protein content was carried out by the Kjehdahl method. 200-500 mg of sample was put into the Kjeldahl flask. Added 10 mL of solid concentrated sulfuric acid and 5 g of catalyst (a mixture of K₂SO₄ and CuSO₄·5H₂O 8: 1) then destructed (in a fume hood) until the liquid is clear green.
After chilling the solution is diluted with distilled water to 100 mL in a measuring flask. The solution was pipetted 10 mL and put into the Kjeldahl distillator and then added 10 mL of 30% NaOH which had been standardized by a solution of oxalic acid. The distillation is carried out for about 20 minutes and the distillate is held in a pre-filled Erlenmeyer 25 mL of 0.1 N HCl solution that has been standardized by borax (the tip of the condenser must be immersed in the HCl solution). Then the excess HCl is titrated with 0.1 N NaOH solution with a mixed indicator of bromoresol green and methyl red.

2.2.5. Total carbohydrate levels
Measurement of total carbohydrate content in a sample is calculated based on calculations (in%)=% carbohydrate = 100% - % (protein + fat + ash + water).

3. Results and Discussions

3.1. Ash content
The result of total ash content determination using the drying ash method on the sample of soybean and red bean cookies was provided in Table 2.

| Samples               | Water-free sample weight (g) | Ash weight (g) | Ash content (%) |
|-----------------------|------------------------------|----------------|-----------------|
| Sample no.387 (soybean cookies) | 10.7193                      | 0.11           | 1.02            |
| Sample no.388 (redbean cookies)   | 7.6648                       | 0.1391         | 1.81            |
| Sample no.389 (redbean cookies)   | 9.5439                       | 0.658          | 1.73            |

The amount of ash in food products depend on the amount mineral raw material used [10]. To avoid the various components undergoing decomposition or even evaporate at high temperatures, the incinerating temperature is adjusted according to the material. For jam samples, the recommended temperature is 525°C-550°C [11]. According to the INS requirement on ash content (maximum 1.6%), only soybean cookies sample no. 387 which meet the condition (ash content 1.02%).

3.2. Water content
The result of water content determination using thermogravimetric method was shown in Table 3.

| Samples               | Sample weight before drying (g) | Sample weight after drying (g) | Water content (%) |
|-----------------------|---------------------------------|-------------------------------|------------------|
| Sample no.387 (soybean cookies) | 46.5178                        | 42.0045                       | 10.744           |
| Sample no.388 (redbean cookies)   | 55.1948                        | 51.7525                       | 6.651            |
| Sample no.389 (redbean cookies)   | 33.2368                        | 27.7885                       | 19.606           |

Water content is the amount of water in a substance which can be represented by weight (wet or dry weight). Moisture content has a major role on the quality of a product. These requirements must be met because the presence of water levels that exceed the standard will cause the product to be overgrown with microbes or other microorganisms so that it will affect its stability. The water content in food determines acceptability, freshness, and affects the shelf life of food, because water can affect physical properties or chemical changes. The content of water in food can influence the texture, presentation and flavor of food. Based on the results, the total water content contained in the soybean cookie sample is 10.744%, while the red bean cookie sample is 6.651% and 19.606%. The decrease in water content is due to evaporation that occurs during the processing of making cookies. When heating process occurs,
the water temperature increases which causes the number of water molecules to decrease and the hydrogen bonds will break and the vapor pressure of the water exceeds atmospheric pressure, as a result the molecules detach from the surface and become gas [12].

According to the INS requirement on water/moisture content (maximum 5%), none of the samples meet the required conditions. This could affect the food stability, physical appearance, texture, etc.

3.3. Fat content
The result of fat content determination using soxhletation method was provided in Table 4.

| Samples                | Sample weight (g) | Fat weight (g) | Fat content (%) |
|------------------------|-------------------|----------------|-----------------|
| Sample no.387 (soybean | 2.4215            | 0.5542         | 22.8            |
| cookies)               |                   |                |                 |
| Sample no.388 (redbean | 1.2955            | 0.4052         | 31.2            |
| cookies)               |                   |                |                 |
| Sample no.389 (redbean | 1.9133            | 0.5262         | 27.5            |
| cookies)               |                   |                |                 |

Fats are glycerol esters, as well as fatty acids. Like carbs, fat is an energy source for the body and can have greater energy content than carbs and 9 kcal/g protein. Fat also functions as a source of flavor and gives a soft texture to the product [13]. Factor which affects fat levels on cookies come from raw materials which used the most part donated by the use of margarine in the making [14]. All of the samples meet the INS requirements on fat content, that is minimum 9.5%.

3.4. Protein content
Numerous methods have been developed to measure protein content. The basic principles of these methods include the determinations of nitrogen, peptide bonds, aromatic amino acids, dye-binding capacity, ultraviolet absorptivity of proteins, and light scattering properties. The Kjeldahl method are one of the commonly used in nutrition labeling and quality control [16]. The result of protein content determination using Kjeldahl method was provided in Table 5.

| Samples                | Sample weight (g) | Protein content (%) |
|------------------------|-------------------|--------------------|
| Sample no.387 (soybean | 0.9603            | 5.375              |
| cookies)               |                   |                    |
| Sample no.388 (redbean | 1.1043            | 13.470             |
| cookies)               |                   |                    |
| Sample no.389 (redbean | 0.9607            | 17.487             |
| cookies)               |                   |                    |

Sample no.388 and 389 meet the INS requirements on protein content, that is minimum 9%, whereas sample no. 387 contained low protein content (5.375%).

3.5. Carbohydrate levels
Carbohydrates are the main source of calories, in addition to also having an important role in determine the characteristics of food ingredients, for example taste, color, texture and others [16].

Overall carbohydrate levels are 100% total sample, reduced by total amount of water, total protein, total fat, and total ash content of the sample. From these results, the total carbohydrate content of soy cookies is 65.256%, in cookies red beans obtained a total carbohydrate content of 44.266% and 48.874%. According to INS requirements, carbohydrate level must be minimum 70%, hence all the samples did not meet the INS conditions and contained low carbohydrate levels.

Carbohydrate levels are by different calculation is influenced by other nutritional components, the lower the other nutritional components carbohydrate levels will be higher. Vice versa, the higher the other nutritional components carbohydrate levels will get lower. Nutrient components that affect the amount of carbohydrate content among them are the content of protein, fat, water and ash [17].
4. Conclusion
The proximate analysis component (protein, ash, fat, water and carbohydrate) correlate with nutrient value of food. Protein levels that are in accordance with INS (have a minimum level of 9%) are red bean cookie (sample number 388 and 389). Ash levels that are in conformity with SNI (have a maximum content of 1.6%) are soybean cookie samples (Sample number 387). All cookies sample are in accordance with INS (has a minimum level of 9.5%). In terms of moisture content and carbohydrate levels, all samples are not INS compliant (maximum 5% and minimum 70%, respectively). Further research is required regarding the effect of storage duration to nutrition value and quality of cookies.

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