Nutritional Value and Consumer Acceptability of Biscotti Made from Rambutan Seed Flour

Mauren Gita Miranti1; Meda Wahini1
1Home Economic Departement, Universitas Negeri Surabaya, Ketintang Street, Surabaya, 60231, Indonesia
E-mail: maurenmiranti@unesa.ac.id, medawahini@unesa.ac.id

Abstract Biscotti is small rectangular bar biscuits containing nuts, twice-baked, oblong-shaped, dry, crunchy, and made from flour, sugar, eggs, pine nuts and almonds. Generally, the flour used is derived from wheat. However, the flour can also be made from rambutan seed that have nutritional value which is good for health. The objectives of this study were to: 1) find the best formula from rambutan seed flour biscotti; 2) know the nutritional value of the selected formula; and 3) know the consumer acceptability. This research was experiment with one factor model in different proportional levels (40; 60; 80; 100), and it analyzed using chemical test and descriptive analysis of sensory quality. The nutritional value of biscotti obtained were compared with nutritional value of rambutan seed flour. These include energy, protein, carbohydrates, fat, ash, Vit C, fiber, and antioxidant. The result showed that 1) the best formula on sensory quality of rambutan seed flour biscotti is resulting from more than a half rambutan seed flour substitutions; 2) the selected formula contain energy, protein, carbohydrates, fat, ash, Vit C, fiber, and antioxidant; and 3) the consumer acceptability of biscotti from the best formula namely: odor, texture, crunchiness, taste and overall acceptability. This study indicate that 60-80 rambutan seed flour can be utilized as potential raw material food for biscotti.

1. Introduction
Biscotti is one of pastry product from Italy made from flour, sugar, eggs, pine nuts and almonds. Biscotti word originated from the Medieval Latin word Biscotto meaning “twice cooked”, which helps in improving its shelf life [1]. In Indonesia, biscotti usually produced in a form of dried brownie with specific addition of dark cooking chocolate or chocolate powder. Previous study has developed nutritional biscotti showed that it is rich in calcium, energy and protein [1]. Other study also developed on replacing wheat flour on pastry product, especially on biscotti and it is conclude that there was a similar sensory characteristic scores between biscotti produced with whole yellow-pea flour and whole wheat flour biscotti [2]. In addition, they also suggested that supplemental ingredients having prominent sensory qualities should be added to pulse-derived products to improve acceptance among consumer [2].

New innovative study on biscotti as functional food is necessary, especially on the efforts to reduce food waste. Food processing wastes are promising sources of valuable compounds such as dietary fiber, antioxidants, essential fatty acids, antimicrobials, minerals which may be used because of their favorable technological, nutritional and functional properties [3]. Food waste in high amount can cause bad impact to the environment [4].

One of high impact food waste derived from high productivity of rambutan in Indonesia. Rambutan production is quite high, as in 2015 it produced a production of 906,438 tons, and a
productivity level of 18.04 tons/ha [5]. Rambutan is a fruit of Sapindaceae family and is a native to tropical regions of Southeast Asia, such as Indonesia, Malaysia, and Thailand [6]. The name for rambutan fruit is derived from the Malay-Indonesian word “rambut” meaning hairy, thus, sometimes it is also named as “hairy litchi” [7]. In Indonesia, there are several cultivars of rambutan with different characteristics, namely Rapiah, Narmada, Sinyonya, Binjai, Garuda, Kapulasan, Lebak bulus, Tangkue Lebak, Bahrang, and Sibongkok [8]. Its consumption results the vast amounts of waste from the seeds and peels of the fruit [9]. Consequently, there is a need for segregate the waste and utilize it into feasible consumed nutritious and healthy product.

In fact, rambutah seed has several nutrition content that is good for human health. Rambutan seed is essentially non-toxic and contains carbohydrates, protein and fat needed by the human body [10], it has good functional properties such as antihyperglycemic activity, antidiabetic, anti-hypercholesterolemia activities, anti-inflammation, anticancer, antioxidant, and antibacterial [9,11]. Rambutan seed is reported to contain proximate composition with a relatively high amount of fat between 17-39%, moisture content 3.52%, crude protein 0.14%, crude fiber 0.32%, carbohydrate 0.43% and ash content of 1.22-2.26% [12-15]. Other than having this high value nutritional content, previous studies has stated that rambutan seed is potential to be used in food application. Rambutan can be as cocoa butter substitute [16-18] has been tested as a low-calorie thickener for replacement of egg yolk or vegetable oil in the formulation of ‘Thousand Island Dressing’ [19]. However, there has not been a study to incorporate rambutan seed flour into pastry product, especially biscotti.

The incorporation of rambutan flour into biscotti will abviously made biscotti has valuable nutrition content. As nowadays consumers’ knowledge and awareness of the health effects of newly developed functional ingredients seems to be rather limited; therefore, there is a strong need for specific communication activities to consumers in this respect [20]. This issue can be solved by conducted liking test and consumer acceptance test. The novel functional food acceptance on consumer is important. As there are several factors that play a role in the response to acceptance of novel foods, it is important to understand ways in which novel foods can be incorporated as a means to diversify diets and increase nutrition profiles [21]. Healthy food can be accepted by the customer also in relation between price and quality is good [19]. The utilization of rambutan seed which derived from unfavourable waste is a low cost material and can obviously reduce production cost in biscotti manufacture. The success of innovations is based on understanding the consumer and then developing relevant products to satisfy the consumer’s needs and desires, which leads to new products being accepted [19].

Based on the potential of rambutan seed as food ingredient in replacing wheat flour, we evaluate the nutritional content and consumer acceptance of biscotti made from rambutan seed flour (RSF), while the study conducted in one of high productivity area in East Java.

2. Materials and Methods

2.1 Ingredients preparation
The ingredients in biscotti production in this study purchased from local bakery and pastry market of Surabaya, Indonesia. The ingredient that is prepared namely wheat flour, baking powder, margarine, milk powder, cocoa powder, dark cooking chocolate, chocolate paste, castor sugar and eggs. The standard formula used is described in Table 1. It is also described the four substitution of RSF percentage to replace wheat flour by F1 (40%), F2 (60%), F3 (80%) dan F4 (100%) based on wheat flour weight as in controlling formulation.

The ingredients in Table 1 was prepared, quality checked, weighted well before use. In this study, the tools used was digital kitchen scale, stainless bowl, flour sifter, dough mixer, spatula, baking sheet and oven. To make sure the experiment controlled, the tools used also the same size and always cleaned before and after used.
Table 1. Biscotti’s standard formula

| Ingredient                  | Amount (g) |
|-----------------------------|------------|
| Rambutan seed flour         |            |
| Control                     | 120        |
| F1                          | 180        |
| F2                          | 240        |
| F3                          | 300        |
| All-purpose flour           |            |
| Control                     | 300        |
| F1                          | 180        |
| F2                          | 120        |
| F3                          | 60         |
| F4                          | -          |
| Baking powder               |            |
| Control                     | 10         |
| F1                          | 10         |
| F2                          | 10         |
| F3                          | 10         |
| F4                          | 10         |
| Milk powder                 |            |
| Control                     | 80         |
| F1                          | 80         |
| F2                          | 80         |
| F3                          | 80         |
| F4                          | 80         |
| Cocoa powder                |            |
| Control                     | 40         |
| F1                          | 40         |
| F2                          | 40         |
| F3                          | 40         |
| F4                          | 40         |
| Margarine                   |            |
| Control                     | 300        |
| F1                          | 300        |
| F2                          | 300        |
| F3                          | 300        |
| F4                          | 300        |
| Dark cooking chocolate      |            |
| Control                     | 300        |
| F1                          | 300        |
| F2                          | 300        |
| F3                          | 300        |
| F4                          | 300        |
| Chocolate paste             |            |
| Control                     | 20         |
| F1                          | 20         |
| F2                          | 20         |
| F3                          | 20         |
| F4                          | 20         |
| Whole eggs                  |            |
| Control                     | 600        |
| F1                          | 600        |
| F2                          | 600        |
| F3                          | 600        |
| F4                          | 600        |
| Castor sugar                |            |
| Control                     | 400        |
| F1                          | 400        |
| F2                          | 400        |
| F3                          | 400        |
| F4                          | 400        |

Source: Bogasari Baking Center (2004)

2.2 Rambutan Seed Flour Preparation Method

Rambutan seed soaked in 1 Liter of Ca(OH)₂ and candle nut solution with the proper percentage of 40% and 30% of 100 gr seed. The seed soaking was conducted for 12 hours, then it drained for being dried in the 50°C temperature oven for 8 hours. After that, rambutan seed is being separated from its husk then mashed into flour. This method was referred to Wahini et al [22-30]. RSF resulted from this method has a good sensory quality such texture as well as wheat flour, therefore, it can be used to replace wheat flour. However, RSF color was bright yellow not as white as wheat flour and also it has higher humidity level than wheat flour. Therefore, prior to use, the RSF is roasted for a minute using frying pan, to get the good dryness.

2.3 Biscotti Preparation Method

For the preparation of biscotti using different amount of RSF substitution, method remained same and controlled as described in Figure 1. After baking, biscotti were cooled to room temperature, packed in polypropylene pouches and sealed till further use.

2.4 Data Analysis

This study uses an experimental method with a completely randomized design (RAL) which only consists of one factor with four different treatments, that is, substitute rambutan seed flour as much 40%; 60%; 80%; dan 100%. The production of rambutan seed flour, biscotti, and acceptance test conducted in the food processing laboratory II, Department of Home economic, Engineering faculty, Universitas Negeri Surabaya. The acceptance level for biscotti was analyzed by descriptive statistical method consisting of 112 respondent. Respondent evaluated the product used 4-likert questionnaire to determine acceptance of biscotti’s sensory quality namely odor, taste, texture, crunchiness, overall acceptability. The questionare was 4-point hedonic scale (dislike very much = 1, dislike = 2, like = 3, like very much = 4). Panelists were asked to taste the biscotti in random order to minimize positional error. The sensory parameters assessed include appearance, color, flavor, texture and overall acceptability.
Nutrient content analysis is carried out at the Industrial Research and Consultation Center (BPKI) Surabaya. The nutrition content that is tested and reported includes energy, carbohydrate, protein, fat, ash, fiber, vitamin C, and antioxidant content.

![Fig. 1. Biscotti production method](image)

3. Results and Discussion

3.1 Sensory quality of Biscotti made from RSF

Values of sensory quality of the biscotti made from RSF substitution are shown in Figure 2. The obtained data analysis is described with biscotti’s sensory quality namely odor, taste, texture, crunchiness, overall acceptability.

![Fig. 2. Biscotti sensory quality result](image)

According to the result showed in Figure 2, formula of the biscotti made from 60% RSF and 80% RSF has similar sensory quality which is the texture is slightly soft when it melt in tongue, has taste and odor like chocolate and slightly bitter. The use of RSF as much as 100% can cause the dough to become very soft and too wet, this is because rambutan seeds do not contain starch or gluten which can absorb liquid from the use of eggs and margarine. As a result, in addition to the dough requires a
longer baking and drying time, the resulting flavor is even more bitter. This happens because of the tannin content contained in rambutan seeds.

Texture is a manifestation of the inner structure of the product that is felt or measured by tactile nerves on the surface of the skin of the hands, lips [23]. The best formula of biscotti texture was made from 80% RSF. This result is in agreement with Ref [1], which texture score of nutritious double chocolate almond biscotti is in very good criteria or in this study, texture score was 3.8 or like criteria.

Crunchiness highest score was in formula F1, more use of RSF produces biscotti which is crunchy but slightly hard or difficult to break. This could be because RSF contains edible fiber. In the manufacturing of RSF biscotti, edible fiber derived from rambutan seeds reacts with gluten contained in wheat flour. The glutinization process that reacts with edible fiber produces a strong texture of the cake, and when dried it will produce a product that is rather difficult to break.

The best taste score is biscotti with 80% RSF substitution, with the specific taste criteria was sweet and less bitter. It is believed that the taste might become bitterer as the more level of RSF substitutions were added into biscotti. The sweet taste is obtained by the effect of using more sugar than the weight of flour, while the taste is slightly bitter due to the flavonoid content in rambutan seeds. This result indicated as the prevouse study by Ref. [24] corroborated that flavonoids have less bitter taste, and the presence of flavonoids and isoflavonoids in foods and their addition as bioactive to food products can impart unpleasant bitterness [25].

RSF does not have a strong odor, so the odor of RSF biscotti depends on other ingredients. The addition of chocolate paste and the use of dark cooking chocolate and cocoa powder in sufficient quantities in the bicotti dough make biscotti odored with dark chocolate. In addition, the odor is also derived from fat incorporation that is margarine. Fat is an important factor which helps in improving the texture as well as rheology and overall quality of the product. Based on the result above, the manifestation of sensory properties can also be affected by factors such as the cooking temperature and ingredients used, and thus influence perception and acceptability [26].

3.2 Consumers Acceptance

From Figure 2 we get the data that RSF acceptance levels are sequentially from F1; F2; F3; and F4 are 3,4; 3,5; 3,8; and 2.1 from the total score 4. This result is in agreement with Ref. [27] which showed that the higher levels of, partially defatted hazelnut flour (12.2–15%) tended to make products less acceptable overall (3.6–4.6; dislike slightly) than the levels (6.1–6.6; like moderately). Therefore, the accepted formula is the F3 formula. Then the formula is tested back to the community to obtain data on community acceptance of the Biscotti RSF. Acceptance test is done through a preference test on sensory quality by 112 respondents. The average acceptability score of the RSF biscotti formula chosen was 3.8 from the highest score 4. It means that in terms of the sensory quality RSF biscotti 80% can be well received by the community, because it has a 95% acceptance. The use of RSF in biscotti can improve product flavor, this is in line with the opinion of Ref. [22] which states that the use of RSF can improve the taste of chocolate brownies due to the bitter taste of tannins contained in rambutan seeds. The measurement of food acceptance is highly complex and relies on psychometrics (scales) and/or behavioral models (food-choice models) [26].

3.3 Nutrition value of semprit biscuit

The nutrition value of RSF biscotti was carried out on the best final product from 4 treatments. The choosen and the highest score of organoleptic test was made of 80% RSF substitution treatment. The nutrition value is reported on Table 2.

The energy of a food product is influenced by the use of fat, protein, and carbohydrate content of other raw materials in the manufacture of pastries [28], fat provides an energy value of 9 kcal, while protein and carbohydrates contribute to each of the 4 kcal energy. In table 2 above it can be seen that biscotti with 80% RSF substitution produces 342.50 kcal of energy. This value still does not meet cookies energy standard based on SNI 01-2973-1992 [29], which states that the quality requirements for biscuits / pastries are having at least 400 kcal of energy, 9% protein, 9.5% fat, and 30% carbohydrate. This unhatch energy content of RSF Biscotti is due to protein and fat content which are
still below the quality requirements, which are 9 and 9.5%, even though the carbohydrate content has met the quality requirements of at least 30%.

Table 2. Nutrition value of biscotti

| Component       | Amount                           | RSF Biscotti                  |
|-----------------|----------------------------------|-------------------------------|
| Wheat flour     | ND                               | 342.50 Kcal                   |
| Soaked RSF      | ND                               | 342.50 Kcal                   |
| Protein         | 9.61%                            | 9.62%                         |
| Fat             | 1.95%                            | 3.58%                         |
| Carbohydrate    | 74.48%                           | 68.1%                         |
| Ash             | 0.3%                             | 0.29%                         |
| Vit. C          | ND                               | 30.5 mg/100g                 |
| Vit. A          | 9 IU                             | 3.48 IU                       |
| Fiber           | ND                               | ND                            |
| Antioxidant     | ND                               | 20% from total starch         |
| USDA (2014)     | ND: not determined               |                               |

The standard protein cookies is a minimum of 9% [29], but the Biscotti RSF only contains protein at 7.96%. RSF biscotti protein content is smaller RSF protein content. The alleviation in the value of protein in the biscotti RSF is due to the process of making biscotti which has twice the roasting, this is in line with the opinion of Ref. [30] which says that the higher the temperature used in food processing can result in decreased protein content in food.

Fat produced by RSF biscotti with 80% substitution is 4.01%. The fat content of RSF biscotti is still below the standard cookie quality, which is > 9.5%, this is because RSF has a low fat, which is 3.85%, so that the use of RSF does not provide a significant contribution to the addition of fat. The source of fat in RSF biscotti is from the use of butter and margarine. The low fat content in RSF biscotti is thought to be a healthy snack for people on a low fat diet.

The fiber content in RSF biscotti is 3.05%. Other study has proved that incorporation of by-product flour into biscuit can increased in total soluble and insoluble dietary fiber as compared to the control in all levels of substitution [31]. RSF has vitamin C content, which is 30.5 mg / 100g. The process of making biscotti which goes through two stages, namely maturation and drying with a high enough temperature makes damage to vitamin C, which is 28.85 mg / 100g.

The enrichment of biscotti with rambutan seed flour also affect on the secondary metabolic content of the product. Secondary metabolic content is a collection of antioxidant compounds [32], the polyphenols are broadly classified into phenolic acids (hydroxybenzoic and hydroxycinnamic acids), flavonoids, xanthones, and stilbenes and constitute an extremely diverse class of secondary metabolites [20]. In addition, secondary metabolites are located primarily in the outer layers of fruits and vegetables and in the seeds. As described table 2 above, biscotti consist only 9.2% antioxidant content from total starch.

4. Conclusions
Based on the results of this research on the nutritional value and consumer acceptance of RSF biscotti, we can concluded that RSF can be used in biscotti production and get accepted by the consumer. Hedonic test which assessed the sensory quality based on the respondent liking of each four product
derived from RSF substitution treatment resulted in difference quality on texture, odor, taste, crunchiness and overall acceptability. In terms of the sensory quality RSF biscotti 80% can be well received by the community, because it has a 95% acceptance. The nutritional content of biscotti made from rambutan seed flour as follow: Energy 342,50 Kcal; Protein 7.96%; Fat 4.01%; Carbohydrate 45.9%; Ash 1.52%; Vit. C 28.85 mg/100g; Fiber 3.05%; Antioxidant 9.2% from total starch. The integration of sensory quality in determining best characteristic of biscotti is necessary to be evaluated as the base part of the next research. The development of the product toward industry scale sector will involve consumer, entrepreneur and government. Therefore, the best final product from this research supposed to be developed into further marketing research and socialized in wider community. In order to give several information about nutritional content of novel product derived from rambutan seed flour.

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