Rambutan Seed (*Nephelium Lappaceum L.*) Optimization as Raw Material of High Nutrition Value Processed Food

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Abstract. Rambutan (*Nephelium Lappaceum L.*) is a plant that identical with Southeast Asian countries, in some areas of Indonesia no exception, but rambutan seed is considered as a waste. Therefore, it needs to be optimized into raw materials of food and processed with high nutritional value and has economic value. The purpose of this research were: 1) to find the best rambutan seed immersion formula; 2) to know the nutritional value of the best immersed rambutan seed; 3) to produce raw material and various processed of rambutan seed product. The research method was quasi experiment with 6 treatments and 2 factorial design, materials for immersion was NaCl and Ca(OH)₂. The results showed that: 1) the best rambutan seed immersion formula was using Ca(OH)₂; 2) the best rambutan seed contains 1.6 ash, 31.2 protein, 26.9 fat; 3) the best rambutan seed produce flour and processed of seasoned nuts. This research indicates that rambutan seed is very potential to be an alternative high-value raw materials.

1. Introduction
Rambutan (*Nephelium lappaceum L.*), family of Sapindaceae is important tropical fruit in Southeast Asian region, no exception in Indonesia, Thailand and Malaysia. Rambutan is a tropical plant which grown in warm, humid and low evaporation rates with high rainfall. Rambutan fruit is potential to be used as functional food due to its capability to provide beneficial health effects. Underutilized part of rambutan (rind and seed) contain some active components which are reported to prevent some diseases (see Figure 1) [1].

![Figure 1. Rambutan seed](image)
Indonesia has 22 varieties of rambutan derived from pure variety and grafting from two different varieties [3]. Rambutan fruit production has increased significantly in this past 7 years. It can be seen from the extensive rambutan season in 2015, which reached 107119 ha, production amounted to 906438 tons, and the level of productivity of 18.04 tons/ha [4]. East Java province is the second largest rambutan producer after West Java province [3]. The largest rambutan fruit production is in Subang with a total production of 87 thousand tons, the second is in Bogor as many as 24 thousand tons, the third is in Semarang as many as 16 thousand tons, the fourth is in Jember with total production 15 thousand tons, and the fifth is in Blitar with totally 13 thousand tons [5]. But, rambutan’s rind and seed is considered as a waste. Rambutan are consumed, fresh, canned or processed and its consumption results in the production of vast amount of rambutan waste from their seeds and rind, disposal of these rambutan wastes can have a serious environmental impact which is becoming harder to solve. Much effort will therefore be needed to develop the nutritional and industrial potential of by-products waste and these underutilized agricultural products [6].

The seeds and rind which are often the waste part of the fruits have not generally received much attention with a view to being used or recycled rather than discarded. Interestingly, the seed and rind of some fruits have higher vitamins, fibres, minerals and other essential nutrients activity than the pulp fractions [7]. Rambutan seeds are safe for consumption because it is not toxic and contains carbohydrate, fat, and protein which consider as the body's needs [8]. Rambutan seed contains quite high polyphenols. Polyphenols are very astringent compounds, consisting of anthocyanins, leucoantosianin 3%, katekhin 3% and complex polyphenols [9]. Main polyphenol compounds are tannins and flavonoids which were identified as geraniin, coraligin, and ellagic acid [10, 11]. That various polyphenols such as antioxidant, antiinflammatory, anticarcinogenic, and other bioactivities demonstrated suggest that they may have beneficial effects on human health and provide protection against such chronic diseases as cardiovascular diseases, neurodegenerative disorders, and cancers [12]. Having this desirable attribute, there is a need to find an appropriate way to remove bitterness from the seed in order to develop flour and seasoned nuts product that can be consumed as valuable nut. Therefore, immersion is one of the preliminary techniques to reduce the amount of tannin, saponin and total phenol content as a cause of bitterness in the seed in this study. Immersion ingredients in this study used 2 type ingredient and 3 different concentration formula which intended to determine the best quality of rambutan seed flour and seasoned nuts from rambutan seed.

2. Methods
The main material used research is Rapiah rambutan seed. Rambutan seeds are obtained from the sellers of rambutan and from collectors of seeds. Seeds that have been obtained by the collectors, wash and then dried under the sun, in order to avoid the growth of fungi that can cause decay in the seeds. Preparation takes ± 3 weeks. Preparing rambutan seed as raw material to produce flour and seasoned nuts is started with peeling rambutan’s rind. Then separate the seeds with the flesh of the fruit, rambutan good seed weight is 6-7 g. In 1 kg of rambutan 100-135 gram rambutan seed can be collected. Immerse the seeds in whiting water for 1 hours, then wash with water and drain it. Drain the seed up, then peel the seed if want to immediately use, and store in an airtight container if saving the seed is desired. Save the seeds in the refrigerator. Rambutan seeds contain fat and protein so it will be easy to quickly rancid, which means damaged if stored at room temperature for a long time. Rambutan seed is a source of protein and carbohydrate can be considered, especially in food application [13].

This study used a quasi-experimental method and implemented in February-July 2017. This study consisted of 2 treatments and each treatment consisted of 3 factors. The materials used are rapiah seeds, Ca(OH)₂ and NaCl. The experiment was conducted in the laboratory of science and food management laboratory of PKK FT Unesa and Balai Penelitian dan Konsultasi Industri (BPKI) Surabaya. The experimental design are shown in Table 1.
Table 1. Experimental design.

|   | P1  | P2  | P3  |
|---|-----|-----|-----|
| R1 | R1P1 | R1P2 | R1P3 |
| R2 | R2P1 | R2P2 | R2P3 |

Note:
P: Percentage of Ca(OH)$_2$ and NaCl
R: Type of immersion
R1: Ca(OH)$_2$
R2: NaCl
P1: 10%
P2: 20%
P3: 30%

3. Results and Discussion

Rapih rambutan seeds have solid criteria, rather round, the outside of the seeds coated with gray-brown leather with a color in a young cream. Seed immersion was done in IPA laboratory of PKK FT Unesa, while laboratory test was done at BPKI on July 26th, 2017. The following result of lab test of nutritional content of rambutan seed of rapih type done at BPKI is shown at Table 2.

Table 2. Composition of Rambutan nutrition substances.

| No. | Analysis Various | Levels of 100% BK |
|-----|-----------------|------------------|
| 1   | Ash content     | 1,70             |
| 2   | Water           | 14,20            |
| 3   | Carbohydrate    | 64,19            |
| 4   | Lipid           | 6,01             |
| 5   | Protein         | 11,38            |
| 6   | Fiber           | 2,51             |
| 7   | Vit. B          | 0,33             |
| 8   | Mineral (Ca-Fe-P) | 62,50        |

Table 2 gives the proximate analysis of the rambutan seeds. The seeds contained 11.38% protein. These nutrient can be used as flour (starch) which its value isn’t lower than other starches. The protein content of defatted rambutan flour (10.07%) was in agreement with that of commercial available all-purpose wheat flour, being normally between 9 and 12% [14]. Another study has shown that amylase content value for defatted rambutan flour (32.16%) differed and was higher than that from all-purpose wheat flour with a value of 17.47% [15]. Therefore, rambutan seeds can be used as flour that can be processed into industrial product such as seasoned fried nuts or chips.

Directly fried rambutan seeds have a bitter taste and if too much to consume it will cause dizziness effects. Rambutan seeds flour without immersion treatment, produce a bitter taste in the product it produces. This is because the seeds have the content of flavonoid. Many flavonoids and iso-flavonoids have an undesirable bitter taste, which hampers their use as food bioactives [16]. Therefore, to eliminate the bitter taste on the rambutan seeds, immersion treatment is necessary by using Ca(OH)$_2$ (whiting) and NaCl (salt). To get the best quality result of rambutan seed, this study used some 3 different formula percentage of Ca(OH)$_2$ and NaCl, which is 10%; 20%; and 30% for each formula. Another study use Ethanol to dissolve flavonoid [17], Ethanol is a solvent that belongs to polar group. Polar solvent is a solvent that can dissolving soil flavonoids and tannins contained in the skin of the fruit and rambutan seed [18].

Percentage of immersion treatment other than used to remove bitterness, also used to find the best nutritional content of rambutan seeds. After immersion, rambutan seeds analyzed its nutritional
content to find the best nutrition. The results of nutrient analysis of rambutan seeds conducted in the Research and Consulting Industry:

**Table 3. Nutrition of rambutan seeds type rapiah after immersion.**

| Various Analysis | 10% Ca(OH)$_2$ Immersion | 20% Ca(OH)$_2$ Immersion | 30% Ca(OH)$_2$ Immersion | 10% NaCl Immersion | 20% NaCl Immersion | 30% NaCl Immersion |
|------------------|---------------------------|----------------------------|---------------------------|--------------------|--------------------|--------------------|
| Ash content      | 1.82                      | 1.90                       | 1.98                      | 2.01               | 2.24               | 2.26               |
| Water            | 14.82                     | 15.11                      | 15.30                     | 15.05              | 15.90              | 16.10              |
| Carbohydrate     | 63.01                     | 62.36                      | 61.78                     | 62.99              | 62.08              | 61.85              |
| Lipid            | 6.12                      | 6.34                       | 6.41                      | 6.04               | 6.02               | 5.96               |
| Protein          | 11.82                     | 11.90                      | 12.08                     | 11.52              | 11.48              | 11.41              |
| Fiber            | 2.41                      | 2.38                       | 2.35                      | 2.36               | 2.33               | 2.31               |
| Vit. B           | 0.31                      | 0.38                       | 0.35                      | 0.36               | 0.35               | 0.34               |
| Mineral (Ca-Fe-P)| 61.85                     | 62.11                      | 62.86                     | 60.05              | 60.15              | 60.05              |

From the results of nutrition analysis in table 3 can be seen that the best nutritional content of rambutan seeds is on treatment 3; the immersion by using Ca(OH)$_2$ as much as 30%. This can be seen from the content of protein and lipid respectively 12.08 and 6.41. As the result of the product that is the reduction of bitterness because Alkaline water (such as aqueous Na$_2$CO$_3$, NaOH and Ca(OH)$_2$ solution) can be used as flavonoid extraction [19]. High lipid (fat) content in rambutan seed has a possible industrial use. The rambutan seed kernels provide a considerable yield of fat and the high arachidic acid content makes that fat highly stable to oxidation. Extracted fat from rambutan seed has a potential to be a source of natural edible fat with possible industrial use [20].

4. Conclusions
From the research result, it is found that that rambutan seed is very potential to be an alternative high-value raw materials and have quite high economic value. This is because rambutan seeds have nutritional value required by the body, including; 11.38% protein, 6.01% crude fat, 64.19% carbohydrate, 2.51% fiber, 0.33% vitamin B, and 62.50% minerals. The most appropriate way to get rid of bitter taste in the seeds is by using immersion formula of 30% Ca(OH)$_2$.

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