Canarium Nut Powder Formulations for Making Crispy Cookies

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Abstract. Almond has been used as basic ingredients in making of crispy cookies. However, almond nut is not native to Indonesia and usually grows in sub-tropical regions with the highest producer from USA. Therefore, other tree-nut species can be used to replace almond in bakery products especially crispy cookies. One alternative is canarium nut (Canarium indicum L.). This research was aimed to determine the exact formulation of canarium nut powder in order to replace almond nut in the making of crispy cookies based on its chemical and sensory characteristics. A Completely Randomized Experimental Design with 5 levels of treatments, i.e: K0: Control (20% almond powder), K1: 10% canarium powder, K2: 20% canarium powder, K3: 30% canarium powder, K4: 40% canarium powder. Results showed that canarium nut powder could be used as a replacement to almond powder for making crispy cookies. The canarium nut powder of 40% was the best treatment to replace almond powder in order to produce crispy cookies with desired characteristics of moisture, ash, protein, fat, fibre and carbohydrate content of 0.66%, 1.60%, 6.40%, 23.29%, 1.23%, and 67.82%, respectively. Crispy cookies with 40% canarium nut powder had sensory characteristics of colour, aroma, taste, crispiness, and overall likeness that were slightly better than the control of 20% almond powder.

1. Introduction
Cookies refer to a baked product generally containing the three major ingredients, namely flour, sugar, and fat. They usually have low moisture contents (1-5%). Other ingredients that can be incorporated in a cookie dough formulation are yeast, chemical leavening, syrup, salt, emulsifiers, but are generally used in minor levels [1]. Cookies can be classified into cabin biscuits, semisweet and hard-sweet biscuits, sugar-snap cookies [2]. One of popular cookies in Indonesia is almond crispy cookies. Almond-based cookies are very popular in all countries. They are made from either ground sweet almonds or sweet almond paste, along with sugar and egg white, although the percentages of these ingredients can vary as a function of the desired final product [3].

Almond nut has been identified as product with health benefits to reduce the risk of coronary heart disease. Almond has low level of LDL cholesterol and high unsaturated fatty acids contents (90%), protein of 20-30%, mineral, vitamin, sterol, and tocopherol [4]. However, almond nut is not native to Indonesia and usually grows in sub-tropical regions with the highest producer from USA and Australia. Since it is being imported, the use of almond nut in the bakery products has been limited due to its high price. Therefore, other tree-nut species can be used to replace almond in bakery products especially crispy cookies. One alternative is canarium nut (Canarium indicum L).

Canarium belongs to genus Burseraceae and is native to eastern Indonesia including Maluku, PNG, and Melanesia [5]. It has the potential to be developed commercially similar to other tree-nut varians such as walnut, hazelnut, cashew, macadamia, and almond. Canarium nut also has health benefits due to its secondary metabolite compounds such as terpene, carboxylic acid, coumarin, furan lipid, and...
phenols (flavonoid, tannin, and phenolic acids) [6]. It also has higher \( \alpha \)-tocopherol content than it is in almond. In addition, its antioxidant activity is far higher than BHT, a synthetic antioxidant [7]. Also, high oil, protein, vitamin and mineral content [8].

Addition of *canarium* nut in the formulation of crispy cookies will affect its quality. The formulation of baked products is important for ensuring palatability and other important sensorial properties, physical and sensorial properties. Therefore, this study was aimed to determine the exact formulation of *canarium* nut powder in order to replace almond nut in the making of crispy cookies based on its chemical and sensory characteristics.

2. Experimental

2.1. Materials

Materials used in this research including *canarium* nut, wheat flour, icing sugar, baking powder, salt, egg, corn starch, and vanilla powder.

2.2. Crispy cookies preparation

The cookies were prepared as per standard recipe of crispy cookies. For the preparation of crispy cookies 50 g of margarine and 80 g of icing sugar were creamed in the mixer. The white egg from two eggs and 0.6 g of salt were added and mixed with high speed for 10 minutes. 100 g of sieved flour, 20g of corn starch, 0.5 vanilla powder, and 2 gram baking powder, as well as the *canarium* nut powder of each 10%, 20%, 30%, and 40% of wheat flour base were added and mixed slowly and smoothly using a spatula. The cookies dough was shaped into thin circular template that had been placed directly on to the aluminium foil coated tray for baking. The cookies were baked at 180°C for 10 minutes. Then cookies were cooled and packed in polypropylene (40 \( \mu \) thickness) pouches and quality evaluated after 24 hours. One batch of control cookies was prepared with 20% almond powder.

2.3. Chemical analysis

The cookies samples were analyzed for, moisture, ash, protein, fat, crude fibre, using the methods of AOAC [9] and Carbohydrate was determined by difference.

2.4. Sensory evaluation

Twenty (20) panelists selected randomly from the university community carried out a sensory evaluation on the cookies samples. These samples were evaluated for the listed quality parameters; colour, aroma, taste, crispiness and over-all likeness. A multiple sample difference test was applied in this research. Each panellist was served 5 samples. One sample was set as standard (almond crispy cookies) refered to R, panellist compared each coded sample with the known standard. One coded sample was a duplicate of the sample. A five point scale was used to compare the samples from standard. 5= far better than R; 4= slightly better than R; 3= similar to R; 2= slightly worse than R; 1= far worse than R.

3. Results and Discussion

3.1. Chemical properties

The result of the chemical compositions of cookies samples are shown in Table 1.

3.1.1. Moisture content

Data indicated that moisture progressively decreased with increasing levels of *canarium* nut powder in crispy cookies (Table 1). Highest moisture (2.11%) was recorded in control 20% almond powder, while the lowest moisture was observed in 40% *canarium* nut powder. Substitution of almond powder to *canarium* powder significantly decreased the moisture content of crispy cookies. The higher the *canarium* nut concentration used in the formulation the lower was the moisture content. Gradual
decrease in moisture content with the increase supplementation of canarium nut powder might be attributed to lower affinity for water due to its lower amount of fibre and fibre usually has strong affinity for water and products containing fibre [10].

### Table 1. Chemical composition of crispy cookies

| Samples                     | Moisture | Ash  | Protein | Fat      | Crude Fibre | Carbohydrate |
|-----------------------------|----------|------|---------|----------|-------------|--------------|
| Control (20% almond powder) | 2.11 a    | 1.25 a| 4.82 bc | 20.24 bc | 2.26 a      | 69.33 c      |
| 10% canarium nut powder     | 1.52 b    | 1.83 a| 4.66 c  | 18.08 d  | 1.29 b      | 72.62 a      |
| 20% canarium nut powder     | 1.20 bc   | 1.46 a| 4.94 bc | 19.96 c  | 1.27 b      | 71.19 b      |
| 30% canarium nut powder     | 0.85 cd   | 1.02 a| 5.09 b  | 21.79 ab | 1.26 b      | 70.00 bc     |
| 40% canarium nut powder     | 0.66 d    | 1.60 a| 6.40 a  | 23.29 a  | 1.23 b      | 67.82 d      |

Means with the same letter in the same column are not significantly (p>0.05) different

#### 3.1.2. Ash content
The ash contents of the crispy cookies ranged from 1.02-1.83% (Table 1) and were not significantly affected by application of canarium nut powder in the formulation. The ash content of any food materials represent the inorganic elements obtained after the combustion of the organic materials in food and these inorganic materials are composed of mineral element (calcium, magnesium, iron, phosporous, etc). These are necessary for constructing firm structures and regulatory functioning of the body.

#### 3.1.3. Protein content
It has been observed from the data that protein content gradually increased with increasing levels of canarium nut powder in crispy cookies (Table 1). The highest protein (6.40%) was observed in sample having 40% canarium nut powder. Lowest protein content (4.66%) was recorded in 10% canarium nut powder. The control treatment had relatively similar protein content with cookies from 20% canarium nut powder. The pulses and nuts usually have high amount of protein, when the sources with quite high protein content are incorporated into the cookies they add protein to it [11].

#### 3.1.4. Fat content
Fat content increased progressively with the increasing levels of canarium nut powder. Fat content of the crispy cookies were in the range of 18.08%-23.29%. The highest fat content was found in cookies with 40% canarium powder (23.29%) and did not significantly differ to 30% canarium powder. The canarium nut itself has high fat content approximately 45.5g/100 g [5]. Fortunately, the canarium nuts mostly contain high amount of unsaturated fatty acid [7] which is beneficial to cardiovascular health. During dough mixing the aqueous phase and the fat compete for the flour surface. The fat surrounds the proteins and the starch granules, isolates them, thereby breaking the continuity of the protein and starch structure and affecting the textural properties of the dough. The produced dough has less elastic properties, which is desirable in cookie-making [1].

#### 3.1.5. Crude fibre content
The data about crude fibre indicated that crude fibre of crispy cookies with canarium nut powder was relatively lower than that of control (almond powder). Increasing levels of canarium powder did not differ significantly in their crude fibre content (Table 1). The difference in the amount of crude fibre was due to the difference in fibre content of almond and canarium nut. High amount of crude fibre is beneficial for their role in the regulation of intestinal transit, lower the serum cholesterol level, constipation, diabetes, colon and breast cancer [12].
3.1.6. Carbohydrate content
The composition of carbohydrate in the cookies samples shown in Table 1 indicated that the values ranged from 67.82% - 72.62% with 10% canarium nut having the highest value. 30% canarium powder had the carbohydrate content that did not significantly differ to control. Results also showed that the higher the levels of canarium nut powder the lower was the carbohydrates content of the cookies. Carbohydrates are the most abundant of all organic compounds hence called hydrate of carbon.

3.2. Sensory properties of cookies
A multiple sample difference test was applied to determine how the sensory properties of the crispy cookies with canarium nut differ to the almond crispy cookies which have been commercially available elsewhere in Indonesia. Results of the sensory evaluation are presented in Fig. 1

![Figure 1. Sensory properties of crispy cookies](image)

3.2.1. Colour
The colour of crispy cookies with 10%, 20%, 30%, and 40% was determined by panellists as to have the colour slightly better (4.05, 3.70, 3.75, and 3.85) than the control almond crispy cookies (R) (Figure 1). Canarium nut crispy cookies had darker colour than almond crispy cookies, in which were perceived better than the lighter almond cookies. The reason of darker colour of the cookies was might be high level of protein present in the canarium nut. As protein reacts with carbohydrates during baking, Maillard reaction takes place which imparts darker colour to cookies.

3.2.2. Aroma
Panellist perceived the crispy cookies with canarium nut powder (10%, 30%, and 40%) as to have aroma which is slightly better (4.05; 3.6; and 3.5) than R the control of almond crispy cookies (Fig. 1). Canarium nut imparted nice aroma to crispy cookies which was determined as slightly better than aroma imparted by almond powder. Aroma of the cookies results from Maillard reaction during baking process, that is the reaction between reducing sugar and amino acid, as well as the caramelization. Amino acids in canarium nut powder were suspected to contribute to the aroma of the cookies.
3.2.3. Taste
The taste of the crispy cookies from canarium nut powder either 10%, 20%, 30%, or 40% was determined by panellists to have a slightly better taste (3.8; 3.55; 3.85; and 3.7) than R almond crispy cookies (Fig. 1). Taste is one the sensory attributes that significantly determine consumer’s preference on food products. Taste of food is largely governed by the formulation of the product [13].

3.2.4. Crispiness
Texture is also one of the important sensory attributes, and more importantly the crispiness of the cookies since the cookies belong to crispy cookies. The crispy cookies with all levels of canarium powder had crispiness which was leading toward what was slightly better (3.6; 3.7; 3.85 and 3.95) than almond crispy cookies (Figure 1). The increase in crispiness of cookies was due to higher protein in canarium nut which resulted in good entrapment of air during dough mixing and made cookies crispier.

3.2.5. Overall likeness
Overall likeness is one of variables used to determine the preference of the panellist on the overall attributes of the product including colour, taste, texture, and aroma. When compared to the R almond crispy cookies, the canarium nut crispy cookies with 10%, 30%, and 40% powder had the overall likeness which was slightly better than the reference. Whereas, cookies with 20% of canarium nut powder had similar overall likeness to the almond crispy cookies (Figure 1).

4. Conclusion
Canarium nut powder can be used to replace almond powder for making crispy cookies. The canarium nut powder of 40% was the best treatment to replace almond powder in order to produce crispy cookies with desired characteristics of moisture, ash, protein, fat, fibre and carbohydrate content of 0.66%, 1.60%, 6.40%, 23.29%, 1.23%, and 67.82%, respectively. Crispy cookies with 40% canarium nut powder had sensory characteristics of colour, aroma, taste, crispiness, and overall likeness that were slightly better than the control of 20% almond powder.

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