Optimization of Oven Temperature on the Chemical Quality of Cookies Made from Cashew Nut Waste Flour

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Abstract. Cashew nuts are the seeds at the very end of the fruit of the cashew plant *(Anacardium occidentale Linn).* The cashew plant produces fruit consisting of two parts, namely pseudo-fruit and true fruit. Pseudo-fruit is a fruit stalk (penduculus) that is fleshy and contains elements of protein, sugar, fat, carbohydrates, minerals and vitamins (A, B and C). The part of the fruit that produces cashews is a true fruit shaped like a kidney embedded at the end of a pseudo-fruit, green to brown, consisting of three layers, namely the hard skin layer (pericarp) consisting of epicarp, mesocarp and endocarp, epidermis layer (teste), and cashew seed layer (kernel). Cookies are a form of food that is easy to carry and is generally preferred by all circles of society. Cashew nut pulp has not been processed properly even though it can be used as a processed food ingredient that has many benefits. This research method uses factorial design 32 with data analysis using ANOVA. The novelty of this study is the use of cashew pulp flour with bleach modification as an ingredient in making cookies. This study aims to test the chemical quality of cookies from cashew nut pulp flour with oven temperature optimization. The chemical quality analyzed is in the form of protein content. It was found that the addition of cashew pulp flour had a significant effect on the protein content of cashew pulp cookies.

1 Introduction

Cashew nuts are the seeds at the very end of the fruit of the cashew plant (Anacardium occidentale Linn), a type of plant from the manga family (family Anacardiaceae). The cashew plant produces fruit consisting of two parts, namely pseudo-fruit and true fruit. Pseudo fruit is actually a fruit stalk (penduculus) that is swollen, inflated, fleshy and contains elements consisting of proteins, sugars, fats, carbohydrates, minerals and vitamins (A, B, and C) [1].

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The part of the fruit that produces cashews is a true fruit, a fruit that belongs to the stone fruit group, shaped like a kidney embedded at the end of a pseudo-fruit, green to grayish-brown, consisting of three layers, namely the hard skin layer (pericarp) consisting of epicarp, mesocarp and endocarp, the epidermis layer (teste), and the cashew seed layer (kernel) [2]. Cashews contain essential nutrients such as fatty acids (40 to 57 grams / 100 grams) [3], including linoleic and oleic acids (20% to 60% of fat content) [4], proteins (20 to 24 grams / 100 grams) [5], carbohydrates (2 to 25 grams / 100 grams) and adequate amounts of micronutrients [6].

In Indonesia, cashews are one of the export commodities with high availability. Central Java Province has an area of 27.881 hectares of cashew nut plants and produces 8.706 tons of cashews per year [7]. In addition to their abundant availability, cashews contain several amino acids and a fairly high fat content of 78-80% [8]. Unsaturated fats acid from cashew nut oil and bioactive compounds such as MUFAs (Mono Unsaturated Fatty Acid), PUFAs (Poly Unsaturated Fatty Acid) [9], phenols [10], and tocopherol which in addition can improve the taste of food and are good for health [11]. Cashews provide 596 kcal energy per 100 grams intake [12]. In addition, cashews contain a large amount of vitamins and minerals [13]. The fatty acid content of cashews can control cholesterol [14] and selenium has been shown to be antioxidants [15], participation in thyroid metabolism [16], and bioactivity in cancer prevention [17]. Cookies are a form of food that is easy to carry and is generally preferred by all circles of society [18]. Based on the quality requirements of cookies according to SNI in 100 grams contribute energy intake of at least 400 kcal [19], 9% protein [20], and 30% carbohydrates [21], but cookies produced are generally types of wheat flour-based foods [22,23]. This research method uses factorial design 32 with data analysis of research results using ANOVA. The novelty of this study is the use of cashew pulp flour with bleach modification as an ingredient in making cookies [24]. This study aims to test the chemical quality in the form of protein content of cookies from cashew nut pulp flour with oven temperature optimization.

2 Materials and method

2.1 Materials

The tools used in this research were baking sheet, oven, sieve, basin, tablespoon, digital scale, glass cup, measuring cup, drip pipette, mold, round bottom flask, clamp, filter paper, porcelain plate, beaker, erlenmeyer, separator funnel, glass funnel, test tube, clamps and statif, and burette. The materials used in this study were petroleum ether, 96% ethanol, aquadest, HCL 0.1N, concentrated H_2SO4, NaOH 0.1N, NaOH 33%, and phenolphthalein.

(a) (b)

Fig. 1. (a) Wet Cashew Dregs, (b) Dry Cashew Pulp.

2.2 Method

2.2.1 Sample preparation

Preparation of materials used such as cashew nut waste flour and wheat flour that has been sifted. Also prepare eggs, margarine, and sugar then all ingredients are weighed according to the variables.

2.2.2 Measurement

The weighing of ingredients was adjusted to variables 1, 2, and 3 for cashew nut waste flour and wheat flour in a ratio of 1:0, 4:1, 3:2. Meanwhile, eggs, margarine, and sugar were weighed the same for the three variables with 50 grams eggs, 17.6 grams margarine, and 5 grams of sugar.

2.2.3 Mixing

After weighing, all ingredients are mixed and stirred thoroughly. Make sure the sugar is also well mixed so that it does not interfere with the roasting process [25, 26].

2.2.4 Pressing dough in mold

The dough that has been smooth will be pressed and then printed with a thickness of 2 cm [27]. The molded dough is placed on a baking sheet that has been given margarine so that it does not stick when removed from the pan after the oven [28, 29].

2.2.5 Baking dough

Optimization of the temperature used between 140-160°C, aims to create a differentiation that will produce the characteristics of cookies with varying protein content values so that it can be seen which temperature is optimal for the oven [30, 31].

2.2.6 Determination of protein content

Protein content testing using the Kjeldahl method [32]. Kjeldahl is divided into three stages, namely the process of destruction, distillation and titration. In the destruction process, the sample is mashed and weighed as much as 1 gram is put into the Kjeldahl flask, then a concentrated 10 ml H2SO4 pipette is inserted into the Kjeldahl flask that has been filled with samples [33]. Add 1gram of selenium to speed up digestion. Then the Kjeldahl pumpkin is heated to a clear green color and cooled. After cooling, the solution is diluted with aquadest in a volumetric flask of 100 ml, aquadest is added to the mark and homogenized. Pipette the resulting 10 ml dilution and put it in a Kjeldahl flask for distillation process [34].

In the distillation process, a 33% NaOH solution is added slowly and the Kjeldahl flask is heated slowly until the two layers are mixed. The distillate is contained in Erlenmeyer which has been filled with 0.1 N HCl as much as 10 ml and examined using litmus paper. If the result is not alkaline, distillation is stopped and the titration process continues [35].

In the distillate titration process, 4 drops of phenolphthalein are added and then titrated with a standard solution of 0.1 N NaOH until a pink color is formed. Repeat the above procedure without samples for blanks. The equivalent point is indicated by a change in color

from purple to blue [36]. The calculation of protein content uses the following formula [37,38]:

$$\%\ Protein\ Content = \frac{Titran\ Sample - Blank)\ x\ N\ HCl\ x\ 14.008}{Sample\ weight\ x\ 1000}\ x\ 100\%$$

2.2.7 Experimental design

Experimental design using factorial design. The fixed variable used in this study was the mass of cashew pulp flour is 297.55 grams. The independent variables used are oven temperature and mass ratio of wheat flour and cashew pulp flour [39].

Table 1. Research Free Variables

Factor	**Low Point**	**Center Point**	**High Point**
	-1	0	1
Temperature (A)	140	150	160
Flour Mass Ratio (B)	1:0	4:1	3:2

2.2.8 Statistical analysis

Statistical analysis in this research using two-way ANOVA and Duncan Multiple Range Test (DMRT) 5% with statistica V.10 application.

Table 2. Research Design Design with Factorial Design

Number	**Factor**	
	A	**B**
1	140	1:0
2	150	4:1
3	160	3:2
4	140	1:0
5	150	4:1
6	160	3:2
7	140	1:0
8	150	4:1
9	160	3:2

3 Results and Discussion

In Table 1 and Table 2 are the results of two-way ANOVA calculations without replication, which have a significant or insignificant effect on the quality of the protein content of cashew nut waste cookies [40] . This is evidenced by the result of F count of 2.7556 while F critical is 6.9442 where F count is greater than F critical which can be interpreted if the ratio of cashew nut flour change [41], the variable will affect but not significantly on the chemical average of cashew nuts, then continued with DMRT (Duncan Multiple Range Test).

Table 3. Summary of Two-way ANOVA Calculations

Summary	Count	Sum	Average	Variance
140ºC	3	0.30194	0.100646667	0.000048139
150ºC	3	0.28222	0.094073333	0.000002404
160ºC	3	0.2784	0.0928	0.000000985
V1 (100:0)	3	0.27731	0.092436667	0.000000459
V2 (80:20)	3	0.28925	0.096416667	0.000024978
V3 (60:40)	3	0.296	0.098666667	0.000049433

Table 4. Results of ANOVA Calculations

Source of Variation	SS	df	MS	F	P-value	F crit
Rows	0.000106	2	0.0000532001	4.90998	0.083773	6.9442
Columns	0.000059	2	0.0000298579	2.75566	0.176862	6.9442
Error	0.000043	4	0.0000108351	-	-	-
Total	0.00020	8	-			

Table 3 and Table 4 show the results of two-way ANOVA calculations without replication, which have a significant or insignificant effect on the quality of the protein content of cashew nut waste cookies. This is evidenced by the result of F count of 2.7556 while F critical is 6.9442 where F count is greater than F critical which can be interpreted if the ratio of cashew nut flour changes, the variable will affect but not significantly on the chemical average of cashew nuts, then continued with Duncan Multiple Range Test (DMRT). In Table 5 based on the Duncan Multiple Range Test (DMRT) 5% it can be seen that the treatment of cashew nut flour with various oven temperatures gave different results on the observed treatment. This can be seen from the symbols of the analysis results that there are the same letters, meaning that the treatment carried out in this study affects the protein content of cookies but is not significant.

Table 5. Results of Duncan Multiple Range Test (DMRT) 5%

Variable	Average	DMRT 5%	Symbol
1	9.173	9.186	a
2	9.250	9.263	b
3	9.298	9.311	c
4	9.308	9.321	cd
5	9.369	9.382	e
6	9.412	9.425	f
7	9.560	9.573	g
8	10.215	10.228	h
9	10.671	-	i

In the show that the addition of cashew nut flour has a significant effect on increasing the protein content of cashew nut waste cookies [34,35]. This is due to the addition of cashew nut waste flour in the dough so that the protein content in cookies is high due to the protein and acid content of cashew nuts which are higher than wheat [44]. According to good protein content in cookies and biscuits is around 9% [45] this is in accordance with SNI 01-2973-1992. In the test results, the lowest protein content was 9.173%. According to [46] the use of high temperatures in the roasting process causes the protein content in food to decrease. The higher the roasting temperature, protein denaturation will occur which results in changes in protein structure by different oven temperatures [47].

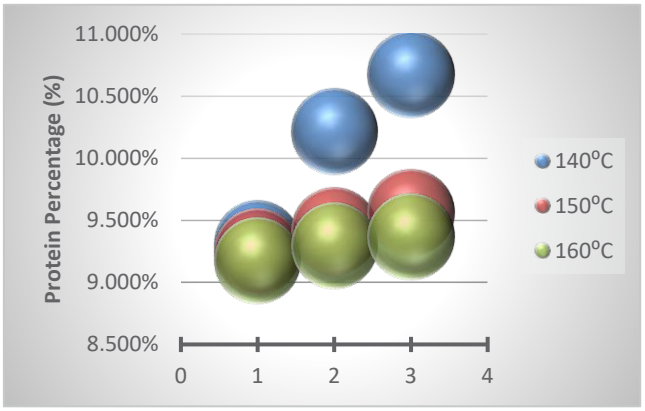

Fig. 2. Protein content percentage

Figure 2 shows that the addition of cashew nut waste flour has a significant effect on the decrease in protein content of cashew nut cookies due to the increase in roasting temperature. According to the use of high temperatures in the roasting process causes the protein content in food to decrease [46]. The higher the roasting temperature, protein denaturation will occur which results in changes in protein structure by different oven

temperatures [47].

4 Conclusion

The results of the analysis of the tests that have been carried out have proven that cashew nut flour has a significant effect on increasing protein content in cookies. Chemically, cashew nuts have more protein content as much as 20-24 grams / 100 grams while wheat is only 13 grams / 100 grams. This allows the cashew nut waste to still contain high enough protein. It can be seen from Table 5 that the results of the protein test using the Kjeldahl method showed a higher protein content in cookies with the addition of cashew nut waste flour compared to cookies without the addition of cashew nut flour. The ANOVA results showed that the protein content of cookies with the addition of cashew nut flour had an effect but not significant.

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