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by Fungki Sri Rejeki

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D Puspitasari[1], F S Rejeki[1], E R Wedowati[1], Koesriwulandari[2] and A Kadir[3]

[1]Study Program of Agro-industrial Technology, Universitas Wijaya Kusuma Surabaya, Surabaya, Indonesia
[2]Study Program of Agribusiness, Universitas Wijaya Kusuma Surabaya, Surabaya, Indonesia
[3]Study Program of Medical, Universitas Wijaya Kusuma Surabaya, Surabaya, Indonesia

E-mail: diana.sidoarjo@gmail.com

Abstract. Biscuits is one kind of processed products that have several advantages, namely durable, easy to consume and easy to digest. Addition of sago flour is intended for adhesives as a substitute for gluten contained in wheat because these biscuit does not use wheat flour or non-gluten. In addition sago to improve the texture of biscuits to be softer if mixed with water. Sago flour has the properties of an adhesive because it contains amylopectin of 62.51%. Carragenan added for produce bicuits product more crispy. The aims of this research were determined the formulation of non-gluten biscuits, and analyzed the chemical properties of non-gluten biscuit. The rese arch used factorial randomized block design with two factors, namely the proportion of composite and sago flour with four levels, and carrageenan concentration with five levels. All treatments were repeated three times. Analysis of chemical data used variance analysis, if there is a significant difference followed by Duncan test with α=5%. The results showed that the best treatment chosen based on the highest expectation value was combination treatment of 100% composite flour: 0% sago flour with 1.5% carrageenan flour. Selected product contain 60.22% carbohydrate, 6.60% water, 3.74% crude fiber, 23.75% fat, and 8.09% protein.

1. Introduction

Utilization of purse can be done by processing it into various types of products to increase added value and use value. Purse water content is quite high, which is 63%, causing the need for proper post-harvest handling or as soon as possible processing the purse into processed products [1]. Likewise, research conducted by Nurani and Yuwono [2] on the use of purse flour as raw material for cookies. Purse flour has a low protein content, so it is made of composite flour of cowpea-purse with a ratio of 50: 50 to increase its protein content [3]. The blend may reduce protein-energy malnutrition in the developing countries because of the effect improved nutritive value of the blend [4].

The substitution study of composite flour of cowpea-purse on wheat flour in biscuit processing has been carried out [3], because wheat flour contains gluten which cannot be accepted by patients with celiac diseases [5]. Celiac diseases is an autoimmune disorder characterized by intolerance to gluten [6]. According to Gallagher et al. [7], The removal of gluten impairs the structure of the dough, causing a liquid batter and also several defects in baked products. The absence of gluten often results in a liquid batter rather than a dough pre-baking, and can result in baked bread with acrumbling texture, poor colour and other quality defects post baking.

According to Di Cairano et al. [8], the easiest product to formulate without gluten is biscuits. The study of cowpea-purse composite flour substitution on wheat flour in the manufacture of biscuits has not been able to achieve 100% substitution because the biscuits produced are easily broken. For this reason, it is necessary to examine substitutes for wheat flour which are adhesive. Compared to bread, gluten plays a minor role in biscuits so a wider variety of flours might be employed [8]. Sago flour has the properties of an adhesive because it contains amylopectin of 62.51% [9]. Organoleptic test results also showed that the texture of biscuits without wheat flour was not liked by the panelists because the texture was too hard, so it needed to add crispy ingredients, namely carrageenan.

2. Method

This research used a randomized block design with two factors. Factor 1 was the proportion of composite flour of cowpea-purse and sago flour (T) with 4 levels, namely: T1 (100%:0%), T2 (85%:15%), T3 (70%:30%) and T4 (55%:45%). Factor 2 was the concentration of carrageenan flour (K) with 5 levels, namely: K1 (0.5%), K2 (1.0%), K3 (1.5%), K4 (2.0%), and K5 (2.5%).

The parameters tested include carbohydrate, protein, fat, water, and ash content. Data processing was carried out by analysis of variance. If there were significant differences, Duncan test was carried out with 95% confidence level by using software SPSS 16.

Selection of alternatives was carried out to determine the best treatment of cowpea-purse composite flour biscuit products in various formulations. Alternative selection used the expectation value method [10]. The concept of the expected value decision is to choose a decision that has a maximum pay-off (profit or usability) or minimum cost (loss or sacrifice). Parameters that used as the basis for selecting alternatives were carbohydrate, protein, fat, water and ash content.

3. Result and discussion

Chemical parameters tested on cowpea-purse composite flour biscuit products include moisture content, ash content, fat content, protein content, carbohydrate content, and crude fiber content. The results of measure those parameters can be seen in Table 1.

3.1. Water content

Water is a major component in food. The presence of water in foodstuffs will affect the texture, taste, appearance and stability. Water content in food is also very influential on the stability and durability of cookies [11]. The results of the variance analysis showed that there was no significant difference between the treatments of biscuit water content. The test results showed that the biscuit water content ranged from 5.08 to 6.60, whereas according to SNI 01-2973-1992, the biscuit water content is a maximum of 5%. The results of measurements of biscuit water content can be seen in Table 1.

In Table 1 showed that the greater the concentration of sago flour added, the water content of biscuits produced tends to be greater too, although it has not shown a significant differences. This is caused by water content in processed food products depends on the water content of the constituent ingredients. According to Puspitasari et al. [3], cowpea-purse composite flour water content is 11.93%, while sago flour water content is 13.1% [9]. Although there were differences in the water content of the constituent ingredients, it did not showed any significant differences in the water content of the biscuits produced. These was thought to be due to the presence of higher amylose in sago flour, because amylose has a nature of absorbent and releases water [2]. Meanwhile, the greater of carrageenan concentration tends not to cause changes in water content.

3.2. Ash content

Ash is an inorganic substance produced by combustion of an organic material, which is related to the amount of minerals present in a substance [12]. The ash content of an ingredient shows the amount of minerals in it, but it cannot be identified whether the mineral is essential or not [11]. In Table 1 it can be seen that the resulting ash content of biscuits ranges from 1.22% to 1.92%. The ash content of cowpea-purse composite flour was able to meet the SNI standard required for toddler biscuits (SNI 01-7111.2-2005) which is a maximum of 3.5%.

The results of variance analysis showed that there were no significant differences between treatments. In Table 1, it can be seen that with the increasing proportion of sago flour, the resulting biscuit ash content tends to decrease, although there has not been a significant differences. This is allegedly caused by differences in ash content in the constituent material. According to Puspitasari et al. [3] the ash content of cowpea-purse composite flour was 4.18%, and the ash content of sago flour was 0.6%, so that with the increasing proportion of sago flour, the resulting ash content of biscuits tends to be lower. That reason is supported by the results of research by Tidore et al. [13] which show that the more starch added, the ash content decreases. Besides that, the increase detected in moisture content possibility that affects the behaviour of this ash content [14].

In Table 1 it is also seen that an increase in carrageenan concentration will cause biscuit ash content to increase. This is presumably because carrageenan contains quite high ash content, which is 15-40% [15], but because the used of carrageenan was only in small concentrations, the increase in ash content has not caused a significant differences.

Table 1. Chemical content of biscuit products for each treatment (%).

Treatment	Parameters					
	Moisture content	Ash content	Fat content	Protein content	Carbohydrate content	Crude fiber content
T1K1	6.48	1.77	23.61	7.75	60.39	3.71
T1K2	6.55	1.87	23.72	7.56	60.13	3.75
T1K3	6.60	1.85	23.57	8.09	60.22	3.74
T1K4	6.40	1.88	23.64	7.74	60.34	3.81
T1K5	6.56	1.92	23.54	7.71	60.27	3.84
T2K1	5.99	1.52	23.50	6.38	62.60	3.69
T2K2	6.14	1.50	23.73	6.33	62.29	3.67
T2K3	5.88	1.57	24.05	6.56	62.17	3.72
T2K4	5.94	1.59	23.68	6.24	62.48	3.71
T2K5	6.04	1.69	23.41	6.21	62.52	3.74
T3K1	5.49	1.42	23.47	5.27	64.35	3.26
T3K2	5.52	1.43	23.48	5.33	64.24	3.37
T3K3	5.50	1.43	23.74	5.35	63.98	3.40
T3K4	5.40	1.47	23.84	5.36	63.92	3.41
T3K5	5.58	1.46	24.02	5.36	63.58	3.44
T4K1	5.08	1.23	23.65	4.44	65.60	2.14
T4K2	5.10	1.24	23.69	4.34	65.39	2.25
T4K3	5.13	1.22	23.59	4.45	65.61	2.68
T4K4	5.15	1.26	23.73	4.52	65.34	2.71
T4K5	5.14	1.27	23.61	4.68	65.44	2.77

3.3. Fat content

In Table 1, it can be seen that the fat content of biscuits produced ranged from 23.41% to 24.05%. This value is above the SNI standard required for toddler biscuits (SNI 01-7111.2-2005) which is 6-18%. This high fat content is thought to be caused by the use of egg yolks as one component of biscuits processing.

The results of variance analysis showed that there were no significant differences between treatments. These was presumably because the fat content in cowpea-purse composite flour and sago flour is very low, that is equal to 0.53% in the cowpea-purse composite flour [3], and 0.06-0.1% in sago flour [16]. Therefore it has no effect on the fat content of the product.

3.4. Protein content

The measurements results of protein content of cowpea-purse composite flour biscuits ranged from 4.34 to 8.09%. In Table 1, it can be seen that the higher the proportion of sago flour, the lower the protein content of biscuits produced. While the increase in carrageenan concentration added tends not to affect the protein content of biscuit produced. This is supported by the research results of Puspitasari et al. [13] and Oksuz and Karakas [17] which show that the more starch flour is added, the protein content decreases. On the contrary, the less sago flour added means the greater the proportion of composite flour containing cowpea flour with high protein content, so the protein content is higher. Meanwhile, the results of research by Man et al. [18] states that the proportion of raw materials that contain a lot of protein will affect the protein content of the products produced. Protein content of biscuits cowpea-purse composite flour with sago substitution of 15% still meets the required SNI standards for toddler biscuits (SNI 01-7111.2-2005) which contains a minimum protein content of 6%. However, substitution of 30% and 45% sago flour did not meet the SNI standards.

The results of variance analysis showed that there were interactions between treatments that were significantly different from the protein content of biscuit produced. Based on the Duncan test results as shown in Table 2, it can be seen that the highest protein content of biscuit were obtained in T1K3 treatment which was 8.09%, while the lowest protein content of biscuit were obtained in T4K2 treatment which was 4.34%. The treatment of T4K2 was not significantly different compared to the treatment of T4K1, T4K3, T4K4 and T4K5.

Table 2. Duncan test notation of biscuits protein content (%).

Treatments	Protein content	Treatments	Protein content
T1K1	7.75[b]	T3K1	5.27[e]
T1K2	7.56[b]	T3K2	5.33[e]
T1K3	8.09[a]	T3K3	5.35[e]
T1K4	7.74[b]	T3K4	5.36[e]
T1K5	7.71[b]	T3K5	5.36[e]
T2K1	6.38[cd]	T4K1	4.44[g]
T2K2	6.33[cd]	T4K2	4.34[fg]
T2K3	6.56[c]	T4K3	4.45[fg]
T2K4	6.24[d]	T4K4	4.52[fg]
T2K5	6.21[d]	T4K5	4.68[fg]

Note: different letters indicate a significant difference between treatments at 95% confidence level

3.5. Carbohydrate content

The results of measurement of carbohydrate content of biscuit ranged from 60.13% to 65.61%. Table 3 shown that the higher the proportion of sago flour, resulting in higher carbohydrate content of biscuits produced. While the increase in carrageenan concentration added tends not to affect the carbohydrate content of biscuits produced.

The results of the variance analysis showed that there was no significant interaction between the treatments for the carbohydrate content of biscuits produced, but the treatment of the proportion of composite flour and sago flour has significant differences on the carbohydrate content of biscuits. Result of Duncan's test (Table 3) shown that each factor level have significant differences. Increasing the concentration of sago flour was paralel to an increase in the carbohydrate content of cowpea-purse composite flour biscuits. The higher content of carbohydrates along with the increase in the concentration of sago flour is expected because sago flour contains higher carbohydrate content compared to the content of carbohydrates in the cowpea-purse composite flour. According to [9], sago contains carbohydrate content of 87.55%, while cowpea-purse composite flour contains carbohydrate content of 77.77% [3]. The calculation of carbohydrate content in the cowpea-purse composite biscuits was done by the method by difference. With this method, the measured types of carbohydrate compounds are starch, sugar, fiber, and oligosaccharides [11].

Table 3. Duncan test notation of biscuits carbohydrate content (%).

Proportion of flour factor	Carbohydrate content
T1 (100%:0%)	60.27^{a}
T2 (85%:15%)	62.41^{b}
T3 (70%:30%)	64.04^{c}
T4 (55%:45%)	65.48^{d}

Note: different letters indicate a significant difference between treatments at 95% confidence level

3.6. *Crude fiber content*

In Table 1 it can be seen that the content of crude fiber of biscuits produced ranged from 23.41% to 24.05%, the greater the level of carrageenan, the greater crude fiber content in cowpea-purse composite flour biscuits. Meanwhile, the greater the concentration of sago flour used, the smaller the crude fiber content in the cowpea purse composite biscuits.

The Table 1 also shown that the greater the level of carrageenan, the greater the crude fiber content in biscuits of cowpea-purse composite flour. Meanwhile, the greater the concentration of sago flour used, caused the fiber content of the cowpea-purse composite flour biscuits was getting smaller.

The results of the analysis of variance showed that there was no significant interaction between factors on crude fiber content of cowpea-purse composite flour biscuits produced, but each factor had a significant affect. Duncan test results (Table 4) showed that carrageenan concentration factor for K1 treatment was significantly different from K4 and K5 treatments, but not significantly different from K2 and K3 treatments. While the treatment of K2, K3, K4 and K5 does not show a significant difference. In Tabel 1 it can be seen that the higher the level of carrageenan, the higher the content of crude fiber biscuits produced. This is presumably because carrageenan contains quite high fiber content, which is 12.78 - 15.95% [19], so that the greater the amount of carrageenan added, the greater the content of crude fiber in the cowpea-purse composite flour biscuits produced.

Table 4. Duncan test notation of crude fiber content (%).

Carrageenan concentration factor	Crude fiber content
K1 (0.5%)	3.20^{b}
K2 (1.0%)	3.26^{ab}
K3 (1.5%)	3.39^{ab}
K4 (2.0%)	3.41^{a}
K5 (2.5%)	3.45^{a}

Note: different letters indicate a significant difference between treatments at 95% confidence level

Duncan test results (Table 5), on the factor of proportion of composite flour and sago flour showed that T1 treatment was not significantly different from T2 treatment, but it was significantly different from T3 and K4 treatments. T2 treatment was not significantly different from T1 treatment, but showed significant differences with T3 and T4 treatments. While, T3 treatment was found to be significantly different from T4 treatment. From Table 1, it can be seen that the higher the proportion of sago flour, the lower the content of crude fiber biscuits produced. This is presumably because sago flour contains relatively low fiber content, which is 1% [9], while the cowpea-purse composite flour contains 3.32% fiber content [3], so that the greater the proportion of sago flour added will cause the lower content of crude fiber in the biscuits produced.

Table 5. Duncan test notation of crude fiber content (%).

Proportion of flour factor	Crude fiber content
T1 (100%:0%)	3.77[a]
T2 (85%:15%)	3.71[a]
T3 (70%:30%)	3.38[b]
T4 (55%:45%)	2.51[c]

Note: different letters indicate a significant difference between treatments at 95% confidence level

3.7. Alternative selection

The best alternative is the treatment with a score of the highest expectation value. Graph of expectation values (EV) of all treatments can be seen in Table 6. In Table 6 shown the highest expectation value was T1K3 treatment with an expectation value of 6.80, while the lowest expectation value was T3K5 treatment with an expectation value of 2.57.

Tabel 6. Expectation value of all treatments.

Treatments	EV	Treatments	EV	Treatments	EV	Treatments	EV
T1K1	6.32	T2K1	5.46	T3K1	4.98	T4K1	4.40
T1K2	5.52	T2K2	4.37	T3K2	4.88	T4K2	3.99
T1K3	6.80	T2K3	3.46	T3K3	3.80	T4K3	4.20
T1K4	6.13	T2K4	4.55	T3K4	3.45	T4K4	3.65
T1K5	6.39	T2K5	5.56	T3K5	2.57	T4K5	4.31

4. Conclusion

Based on the results of the research it can be concluded that the combination between factors did not significantly affect the parameters of water content, ash content, fat content, carbohydrate content, and crude fiber content, but has a significant effect on protein content. The proportion of cowpea-purse flour and concentration of carrageenan individually had been a significant effect on carbohydrate content and crude fiber content, whereas carrageenan concentration factor had been a significant effect on crude fiber content.

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