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Effect of the Addition of Tapioca Flour and Moringa Leaf Puree (*Moringa oleifera*) on Proximate Analysis of Shellfish Siomay

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A B S T R A C T

Moringa leaf puree is rich in amino acids, making it a valuable nutritional ingredient, while tapioca flour, due to its amylose and amylopectin content, enhances the chewiness of food products. Mollusks, particularly clams and snails, are excellent sources of protein and minerals. This study aimed to evaluate the effects of tapioca flour and moringa leaf puree addition on the nutritional composition of siomay made from shellfish. A randomized block design with two factors was employed: (1) the type of shellfish (blood clam, green clam, and rice snail) and (2) the proportion of tapioca flour to moringa leaf puree (50:50, 75:25, and 100:0). The best formulation was obtained from siomay made with rice snail and a tapioca flour-to-moringa puree ratio of 75:25, yielding a moisture content of 50.14%, ash content of 5.6%, fat content of 2.82%, protein content of 9.84%, and carbohydrate content of 31.60%.

Contribution to Sustainable Development Goals (SDGs):
SDG 2: Zero Hunger.
SDG 3: Good Health and Well-being.
SDG 12: Responsible Consumption and Production.
SDG 14: Life Below Water

1. INTRODUCTION

1.1. Research Background

Siomay contains animal-based protein because its main raw material comes from meat. Animal-based protein is a good source of protein, but adding vegetable-based protein sources can produce an amino acid composition that is of high quality [1]. The addition of vegetable-based protein can improve the nutritional quality of siomay [2]. One of the vegetables that can be used is moringa leaves.

Moringa leaves (Moringa oleifera) have high nutrition with a crude protein content of 26.79% [3], vitamins and minerals [4]. Moringa leaves have nutritional content recognized as proximate components such as protein, carbohydrates, fat, water, and ash. Proximate components will provide complementary effects to the effects of Moringa secondary metabolites as antioxidants [5]. Moringa has the potential as a fortification to enrich the nutritional content of siomay. Processing moringa leaves into puree can maintain its nutritional content because it does not undergo a heating and drying process at high temperatures so that the nutritional content.

The problem in making siomay is that the texture of the siomay can become hard due to excessive heating. Therefore, it is necessary to add other ingredients that act as fillers and binders. The purposes of adding binders and fillers are to improve the consistency of shape and texture by maintaining the sensory properties of meat so as to reduce fat content and increase water binding [6].

The filling ingredient commonly used in making siomay is wheat flour. However, wheat is not native to Indonesia so the fulfillment of wheat needs in Indonesia is carried out by imports. If Indonesia depends on imports to meet domestics needs, it will

certainly take a large amount of foreign exchange, which can affect national food security [7]. Wheat is a source of gluten, which if consumed in excessive amounts can trigger Celiac Disease. Therefore, other fillers such as tapioca flour derived from cassava are needed.

Tapioca flour is characterized by a shiny appearance, good adhesion, smooth texture, and does not produce flavor in processed products [8]. The use of tapioca flour is expected to replace the role of wheat flour as a texture-forming ingredient in making siomay and produce siomay with a chewier texture.

In Indonesia, siomay is generally made from beef, chicken, shrimp, and mackerel. These meats are relatively expensive so it is necessary to substitute more economically priced ingredients, such as clams and snails. Clams and snails have excellent benefits regarding protein and mineral content that can help meet people's food needs [9].

Mollusks, such as clams and snails contain amino acids, essential fatty acids, vitamin B6, B12, minerals calcium, phosphorus, iron, zinc, selenium, and magnesium [10]. The high nutritional value and abundance of mollusks indicate an opportunity for utilization as one of the raw material fillings in siomay.

Therefore, this research will study the effect of adding the proportion of tapioca flour and moringa leaf puree on water content, ash content, fat content, protein content, and carbohydrate content in siomay from blood clams, green clams, and rice snails.

2. MATERIALS AND METHODS

2.1. Materials

The materials used in this study include tapioca flour "rose brand", egg white, garlic, green onions, salt, sugar, pepper, blood clams, green clams, rice snails, moringa leaves, and siomay wrapper "ikiae" obtained from the Gresikan traditional market, Bronggalan, Surabaya. The materials used for analysis were n-hexane (Merck), kjeldahl tablets (Merck), bromocresol green solution (Merck), methyl red solution (Merck), and hydrochloric acid (Merck).

2.2. Research Procedures

Weighing the ingredients according to the treatment. Blood clams, green clams, and rice snails as much as 25 g were cleaned, then ground using a food processor. The dough was mixed with additional ingredients such as salt 2 g, sugar 0.8 g, pepper powder 0.8 g, garlic 2 g, spring onions 2 g, egg white 4 g, and mixed until smooth. The proportion of tapioca flour and moringa leaf puree (37.5 g : 37.5 g; 56,25 g : 18,75 g; 75 g : 0 g) was added. The dough that has been mixed well, shaped like a ball and wrapped using siomay wrapper. The dough was steamed for 30 minutes at 100°C. Then proceed to analyze the water content (AOAC, 2005), ash content (AOAC, 2005), fat content (AOAC, 2005), protein content (AOAC, 2005), and carbohydrate content (AOAC, 1995).

2.3. Research Design

This research design used a randomized block design with two factors, namely factor I and factor II, each consisting of three levels and repeated 3 times. Factor I is the type of blood clam, green clam, and rice snails. Factor II is the proportion of tapioca flour and moringa puree (50:50; 75:25; 100:0 w/b). Observation data were analyzed using Two Way ANOVA with a significant level of 5%, if there is an interaction or significant effect between the two treatments, DMRT 95% further test will be conducted.

3. RESULT AND DISCUSSION

3.1. Moisture content

The moisture content of siomay will decrease as tapioca flour increases or the lower proportion of moringa leaf puree. The addition of a higher proportion of tapioca starch results in higher water binding, but at heating temperatures tapioca starch will absorb water and form a gel due to the gelatinization process. When the mixture of starch and water is heated, the starch granules begin to absorb water and swell. As a result, the starch granules lose their shape and release the starch molecules into the solution. The previously bound water will be trapped into the formed starch network structure. Amylopectin has the property of being difficult to bind water, but if it is bound it can retain so that the bound water is no longer in free form. As a result, the bound water can be trapped in the gel structure and the measured amount of water in the siomay becomes lower because the water is no longer in liquid form [11].

Moisture content in food ingredients also shrinks after the cooking process because the cooking process generally uses high temperatures up to the boiling point of water (100°C) [12]. High temperatures increase the rate of evaporation so that a lot of water is lost from the food. During the heating process, heat energy causes water molecules in food to move faster and eventually evaporate into the air. This is supported by the results of research which show that the longer time and higher temperature in steaming process, the moisture content of egg white sausage will decrease [13].

Differences in the type of shellfish showed that rice snails reduced water content of siomay. This is due to the relatively smaller water content of rice snails (40.04%) [14] compared to blood clams (77.73%) [15] and green clams (78.86%) [16]. The difference in moisture content between mollusks can be caused by thick shell morphology, thin meat structure, and type of shellfish [17]. The moisture content of mollusks, especially clams and snails are strongly influenced by their physical condition and body structure [18].

3.2. Ash content

The ash content of siomay will decrease with the addition of tapioca flour or the reduction of moringa leaf puree. This is because tapioca flour has a relatively small ash content (0.18%) [19] compared to moringa leaf puree (2.01%) [2]. Moringa leaves contain several minerals that can increase the ash content of siomay so that it can present mineral levels in food ingredients. The mineral sources contained in moringa leaf puree are very good because they contain 440 mg of calcium, 70 mg of phosphorus, and 7 mg of iron [20].

Differences in the type of shellfish showed that rice snails increased the ash content of siomay. This is because rice snails contain higher ash content (8.53%) [14] compared to blood clams (1.84%) [21] and green clams (3.6%) [16]. Differences in ash content in mollusks can be caused by several factors such as shell composition and different living environments [22]. Each aquatic environment can provide different mineral intake for aquatic organisms that live in it. Each organism also has a different ability

to regulate and absorb minerals, which will affect the ash content of each ingredient.

3.3. Fat content

The fat content of siomay will decrease as tapioca flour increases or the lower proportion of moringa leaf puree. This is because moringa puree has a greater fat content (1.75%) [23] than tapioca flour (0.5%) [24]. Therefore, the more proportion of tapioca flour used, the fat content of the resulting siomay will also decrease.

Differences in the type of shellfish showed that rice snails increased the fat content of siomay. This is due to the relatively higher fat content of rice snails (2.7%) [14] compared to blood clams (0.6%) [21] and green clams (0.7%) [16]. The difference in fat content in mollusks is influenced by several factors, namely food, age, and the physiological properties of animals that will go to the breeding phase because it requires a lot of energy stored in the form of fat [25]. The larger size of the animal, the higher fat content because of accumulation of lipids in its body parts [17]. In addition, low fat content can be caused by higher water content in clams compared to snails, so proportionally the percentage of fat content will drop dramatically.

3.4. Protein content

The protein content of siomay will decrease with the addition of tapioca flour or the reduction of moringa leaf puree. This is because tapioca flour has a smaller protein content (0.59%) [19] than moringa puree (8.85%) [23]. These results are in line with research on the decrease in nugget protein levels along with the increase in the concentration of tapioca flour added, where the lowest protein levels were found in the highest tapioca addition treatment [19].

Differences in the type of shellfish showed that rice snails reduced the protein content of siomay. Rice snails have a relatively smaller protein content compared to clams. The high and low value of protein in an organism is caused by the availability of food and the level of protein consumption in its food [10]. However, their ability to digest food also varies [26]. Variations in protein content can be caused by several factors including habitat, age, digested food, metabolic rate, movement rate, and level of gonad maturity [27]. The protein content in mollusks meat depends on species, nutritional conditions, and muscle [17].

Table 1. Analysis Results of Moisture Content, Ash Content, Fat Content, Protein Content, and Carbohydrate Content

Treatment		Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Carbohydrate (%)
Types of Clams/ Snails	Tapioca Flour and Moringa Puree					
Blood Clams	50 : 50	$51.61^{a} \pm 0.07$	$0.80^{g} \pm 0.02$	$0.73^{g} \pm 0.041$	$13.12^{a} \pm 0.02$	$33.74^{d} \pm 0.12$
	75 : 25	$50.44^{b} \pm 0.44$	$0.59^{h} \pm 0.03$	$0.63^{h} \pm 0.017$	$12.50^{b} \pm 0.02$	$35.84^{b} \pm 0.46$
	100 : 0	$49.40^{c} \pm 0.41$	$0.42^{i} \pm 0.03$	$0.58^{i} \pm 0.013$	$10.91^{f} \pm 0.02$	$38.68^{a} \pm 0.41$
Green Clams	50 : 50	$51.17^{a} \pm 0.29$	$1.89^{d} \pm 0.04$	$1.49^{d} \pm 0.005$	$12.09^{c} \pm 0.03$	$33.36^{d} \pm 0.35$
	75 : 25	$50.43^{b} \pm 0.18$	$1.79^{e} \pm 0.03$	$1.37^{e} \pm 0.010$	$11.79^{d} \pm 0.02$	$34.62^{c} \pm 0.21$
	100 : 0	$49.24^{c} \pm 0.18$	$1.66^{f} \pm 0.01$	$1.28^{f} \pm 0.007$	$9.627^{g} \pm 0.54$	$38.19^{a} \pm 0.56$
Rice Snails	50 : 50	$50.93^{ab} \pm 0.45$	$5.80^{a} \pm 0.01$	$2.97^{a} \pm 0.009$	$11.39^{e} \pm 0.05$	$28.90^{f} \pm 0.40$
	75 : 25	$50.14^{b} \pm 0.69$	$5.59^{b} \pm 0.03$	$2.82^{b} \pm 0.007$	$9.844^{g} \pm 0.02$	$31.60^{e} \pm 0.71$
	100 : 0	$47.77^{d} \pm 0.46$	$5.48^{c} \pm 0.03$	$2.68^{c} \pm 0.004$	$7.959^{h} \pm 0.05$	$36.09^{b} \pm 0.51$

Notes: Mean values accompanied by different notations indicate significant differences ($p \leq 0.05$)

3.5. Carbohydrate content

The carbohydrate content of siomay will increase with the addition of tapioca flour or the reduction of moringa leaf puree. This is because tapioca flour has a carbohydrate content of 88.2% [24]. The increase in the proportion of tapioca flour results in an increase in the total carbohydrate value due to the swelling of starch granule molecules. The swelling of starch granules by water causes the molecular weight of starch to increase, increasing total carbohydrate content [28]. This is in line with the research where the greater addition of tapioca flour, the greater starch content in the dough so that the carbohydrates of meat crackers increase [29].

Differences in the type of shellfish showed that rice snails decreased the carbohydrate content of siomay. Carbohydrate levels in mollusks meat vary in relation to the availability of food at each organism's origin. Mollusks groups obtain carbohydrates from phytoplankton and organic substances absorbed from each place [30]. The habitat conditions of each place are different which causes the availability of food for mollusks to be different.

4. CONCLUSION

From the research, it can be concluded that the addition of tapioca flour and moringa leaf puree affects the nutritional content of shellfish siomay. The results showed that there was a significant interaction between the addition of tapioca flour and moringa puree in siomay from blood clams, green clams, and rice snails on moisture content, ash content, fat content, protein content, and carbohydrate content. The results of the analysis of the best treatment were in the siomay of rice snail with the proportion of tapioca flour and moringa puree (75:25). The results obtained include water content of 50.14%, ash content of 5.6%, fat content of 2.82%, protein content of 9.84%, and carbohydrate content of 31.60%.

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