Fisheries Journal, 15 (4), 2321-2329 (2025)
http://doi.org/10.29303/jp.v15i4.1422

CALCIUM ENRICHMENT IN NASTAR CAKES WITH GREEN GIANT SHRIMP (Macrobrachium rosenbergii) SHELL WASTE FLOUR

Pengkayaan Kalsium Pada Kue Nastar dengan Tepung Limbah Cangkang Udang Galah (*Macrobrachium rosenbergii*)

Tyas Wara Sulistyaningrum*, Evnaweri, Rawati Anggraeni Dakhi

Fisheries Product Technology, Palangka Raya University

*Corresponding Author: lilis_tyasningrum@fish.upr.ac.id

(Received February 18th 2025; Accepted August 22th 2024)

ABSTRACT

The high production of prawns produces by-products that are not utilized, especially in the industrial sector which only uses prawn meat and produces waste from prawn shells. One alternative to solve the problem of prawn shell waste is to process shrimp shells into flour which can be used as the main ingredient in processing pineapple cakes and as a source of calcium. Pineapple tart is one of the pastries that is high in calories. The nutritional content of Pineapple tart is not much different from other types of pastries, the content in it is more dominant in fat because it contains a lot of margarine, wheat flour and eggs. Meanwhile, the calcium content in pineapple tart is only found in the cheese which is used as the top layer for pineapple tart (topping). Therefore, it is necessary to conduct research on making pineapple tart by substituting prawn shell flour (*Macrobrachium rosenbergii*) as a source of calcium because calcium is a mineral that is important for humans for the growth and maintenance of bones and teeth. This research was conducted to determine the characteristics of Pineapple tart with the addition of prawn shell flour (Macrobrachium rosenbergii) as a source of calcium. This research used a Completely Randomized Design (CRD) method with 4 treatments, namely A (without the addition of waste shell flour), B (addition of 2.5% waste prawn shell flour, C (addition of 5% waste shell flour), and D (addition of waste flour shell 7.5%). The results of this study found that the best Calcium content value was obtained from treatment B which was 680.91 mg and fulfilled the Calcium intake per day which is between 600-1200 mg per day.

Keyword : Calcium Enrichment, King Prawn Shell, Waste

ABSTRAK

Tingginya produksi udang galah menghasilkan hasil samping yang tidak dimanfaatkan, terutama di bidang industri yang hanya memanfaatkan daging udang dan menghasilkan limbah dari cangkang udang. Sebagai salah satu alternatif untuk memecahkan masalah limbah cangkang udang adalah mengolah cangkang udang menjadi tepung yang dapat dimanfaatkan sebagai bahan utama pada pengolahan kue nastar dan menjadi sumber kalsium. Kue nastar adalah salah satu kue kering yang tinggi kalori. Kandungan nutrisi pada kue nastar tidak jauh berbeda dengan jenis kue kering lainnya, kandungan di dalamnya lebih dominan lemak karena

mengandung banyak margarin, tepung terigu dan telur. Sedangkan kandungan kalsium pada kue nastar hanya terdapat pada keju yang digunakan sebagai bahan pelapis atas pada kue nastar (*topping*). Oleh karena itu, perlu dilakukan penelitian mengenai pembuatan kue nastar dengan substitusi tepung cangkang udang galah (*Macrobrachium rosenbergii*) sebagai sumber kalsium karena kalsium adalah mineral yang penting bagi manusia untuk pertumbuhan dan pemeliharaan tulang dan gigi. Penelitian ini dilakukan untuk mengetahui karakteristik kue nastar dengan penambahan tepung cangkang udang galah (*Macrobrachium rosenbergii*) sebagai sumber kalsium. Penelitian ini menggunakan metode Rancangan Acak Lengkap (RAL) dengan 4 perlakuan yaitu A (tanpa penambahan tepung limbah cangkang), B (penambahan tepung limbah cangkang udang 2,5%, C (penambahan tepung limbah cangkang 5%, dan D (penambahan tepung limbah cangkang 7,5%). Hasil penelitian ini, mendapatkan bahwa nilai kadar Kalsium terbaik didapatkan dari pada perlakuan B yaitu 680,91 mg dan telah memenuhi asupan kalsium perhari yaitu antara 600-1200 mg perhari

Kata Kunci : Cangkang Udang Galah, Limbah, Pengkayaan Kalsium

INTRODUCTION

Giant freshwater prawns (*Macrobrachium rosenbergii*) are a type of freshwater shrimp found in rivers, lakes, and swamps. Giant freshwater prawns are one of the largest freshwater shrimp species, reaching 32 cm in length. Giant freshwater prawns are a leading commodity in the fisheries industry due to their economic value and high market demand. Giant freshwater prawn production has increased year after year, with a cultivation potential of 20 tons per day. Giant freshwater prawn production reached 900 tons in 2012, 1,100 tons in 2013, and a 36.4% increase in 2014, reaching 1,500 tons (Ministry of Maritime Affairs and Fisheries, 2014).

High giant freshwater prawn production results in underutilized byproducts, particularly in industries that utilize only shrimp meat and produce waste from the shells. One alternative to solving the problem of shrimp shell waste is processing the shells into flour, which can be used in pineapple tarts and as a source of calcium.

Nastar cookies are cookies made from a mixture of wheat flour, butter, and eggs filled with pineapple jam. They are baked in an oven, resulting in a crispy texture. Nastar comes from the Dutch words "Ananas" (nanas) and "Taart" (tart/pie), meaning pineapple tart. Nastar cookies are a popular traditional Indonesian cookie. They are typically served during major celebrations such as New Year's, Eid al-Fitr, and Eid al-Fitr (Muhammad & Rizki, 2020).

Nastar cookies are high in calories. Their nutritional content is similar to other cookies, but they are predominantly high in fat due to the high content of margarine, wheat flour, and eggs. According to Fatsecret, one slice of nastar contains approximately 75 calories, 2.14 grams of fat, 12.66 grams of carbohydrates, and 1.4 grams of protein. The calcium content in nastar cookies is found only in the cheese used as a topping. Therefore, it is necessary to conduct research on making nastar cakes by substituting giant freshwater prawn shell flour (Macrobrachium rosenbergii) as a source of calcium because calcium is an important mineral for humans for the growth and maintenance of bones and teeth.

Calcium is the most abundant mineral required by the body. The daily requirement is 800 mg for adults over 25 years of age, and 1,000 mg after age 50. Pregnant and breastfeeding women should consume 1,200 mg of calcium per day. Approximately 99% of calcium is found in bones and teeth, with the remainder in the blood and body cells. This study aims to determine the characteristics of nastar cookies enriched with calcium from giant freshwater prawn (*Macrobrachium rosenbergii*) shell flour.

RESEARCH METHODS

This research was conducted experimentally using a Completely Randomized Design (CRD) with four treatments: A (no addition of shell waste flour), B (addition of 2.5% shrimp shell waste flour), C (addition of 5% shell waste flour), and D (addition of 7.5% shell waste flour). The research was conducted in December 2023 at the Fisheries Product Technology Laboratory, Fisheries Department, Palangka Raya University. Chemical testing was conducted at the Palangka Raya Goods Quality Certification Testing Center (BPSMB) Laboratory. The research procedure can be seen in Figure 1.

The tools used in this study included an oven, blender, digital scale, baking pan, stove, knife, tray, 50 cm flour sieve, frying pan, spatula, basin, and brush. The ingredients used were wheat flour, shrimp shell flour, pineapple jam, butter, egg yolk, vanilla powder, and grated cheese.

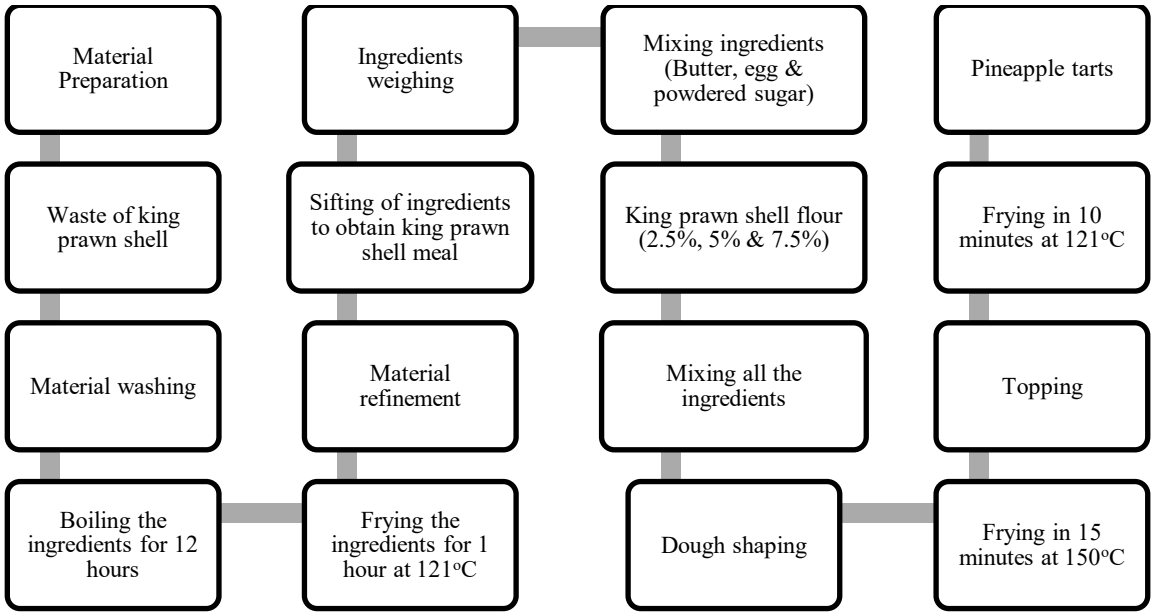

Figure 1. Flowchart of Nastar Cake Processing Procedure with Flour from Giant Freshwater Prawn Shell Waste

RESULT

The following are the results of chemical tests on water content, protein content, fat content, carbohydrate content and calcium content in cakes made from flour from giant freshwater prawn shell waste.

Table 1. Chemical Test Results of Nastar Cake with Flour from Giant Freshwater Prawn Shell Waste

Sample Code	Water (%)	Protein (%)	Fat (%)	Carbohydrate (%)	Calcium (mg)
A	9.88±0.91^{a}	2.62±0.25^{c}	22.5±0.02^{a}	63.73±0.47^{d}	86.148±11.22^{a}
B	11.64±0.2^{b}	2.21±0.56^{a}	22.99±0.49^{b}	61.65±0.26^{c}	680.910±58.12^{b}
C	12.00±0.72^{c}	2.55±0.43^{bc}	24.26±0.55^{c}	59.34±0.15^{a}	1659.239±279.59^{c}
D	12.11±0.58^{a}	2.41±0.19^{ab}	24.36±0.35^{c}	61.31±0.23^{b}	2437.323±81,95^{d}
SNI 2973:2011	Max. 5	Min. 6	Min. 18	Min. 70	-

DISCUSSION

1. Water content

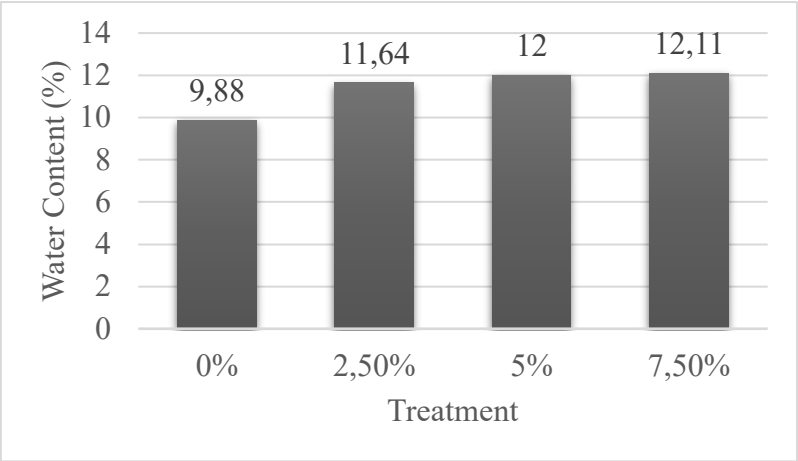

Figure 2. Average Water Content

Moisture content plays a crucial role in determining the shelf life of a food product because it can influence physical properties, chemical changes, microbiological changes, and enzymatic changes (Buckle, K.A., 1987).

The highest moisture content was found in treatment D at 12.11%, while the lowest moisture content was found in treatment A at 9.88% (Figure 2). The moisture content of nastar cookies with the addition of giant freshwater prawn shell flour did not meet the quality requirements for cookies set by the Indonesian National Standard (2011), which is a maximum of 5%.

The water content of nastar cookies increased in each treatment. This was due to the increasing addition of giant prawn shell flour in each treatment and the reduction in the amount of wheat flour in the ingredients. According to Ishak *et al.* (2023), the water content of cookie products can be influenced by the characteristics of shrimp flour, a material in which shrimp flour is composed of two types of polymers, namely amylose and amylopectin. According to Ikhsan (1996), amylose is a starch component that has a straight chain and is soluble in water, while amylopectin has a branched chain and is insoluble in water but soluble in n-butanol. This is because amylose is composed of a straight chain of D-glucose bonded with α-1,4.

2. Protein Content

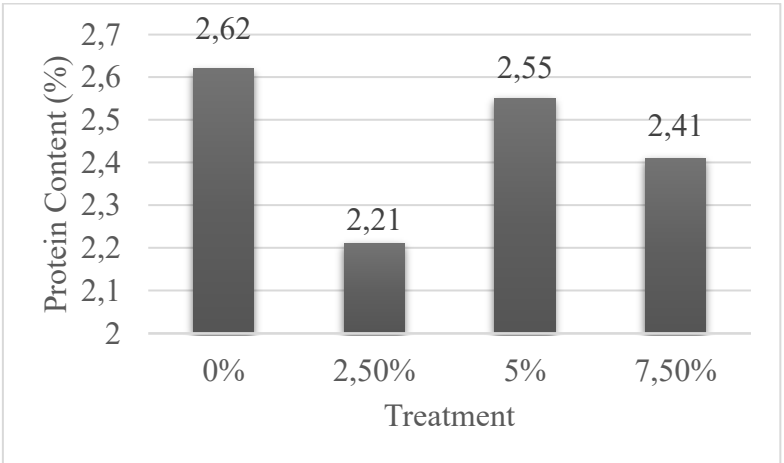

Figure 3. Average Protein Content

According to Winarno (1989), protein is a source of amino acids, both essential and non-essential. The protein content in a food ingredient determines its quality.

The highest protein content was found in treatment A (2.62%), while the lowest protein content was found in treatment B (2.21%) (Figure 3). The protein content of nastar cookies with the addition of giant freshwater prawn shell flour did not meet the quality requirements set by the Indonesian National Standard (2011) for cookies, which is a minimum of 6%.

According to Passos *et al.* (2013), the protein content of some commercial biscuits and crackers varies from 3 to 14.6%. The total protein content of biscuits is influenced by the protein content of the added fish bone meal, as fish bone meal is known to have a high protein content. Tilapia bone meal is known to contain up to 40.8% protein (Petenuci *et al.,* 2008), tuna bone meal contains 29-56% protein (Adriani *et al.,* 2012), and catfish head meal contains 9.9-11.4% protein (Ferazuma *et al.,* 2011).

The protein content of cookies is influenced by the protein content of the flour, the main ingredient (Darmajana *et al.,* 2020). High gluten content will affect the protein content of the product, so when added to a product, it can increase the protein content.

3. Fat Content

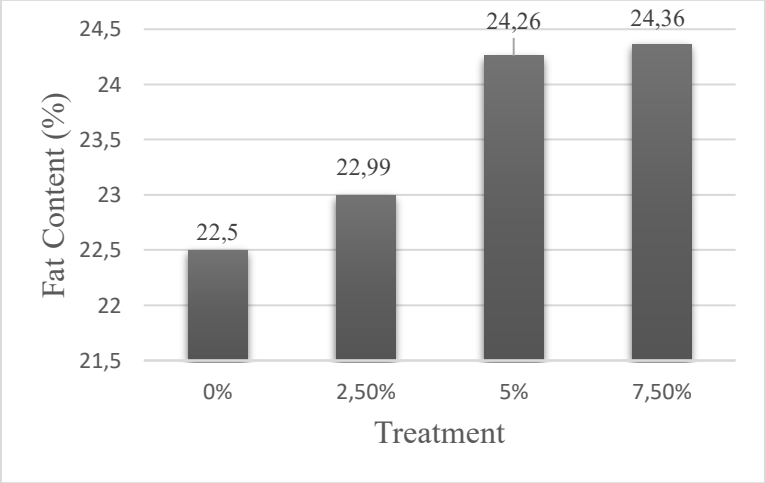

Figure 4. Average Fat Content

According to Ketaren (2005), high fat content accelerates rancidity reactions, which occur due to enzyme activity in contact with air and water. Fat is not readily utilized directly by microbes compared to protein and water, but yeast and bacteria can utilize anaerobic carbon in fat-containing media, converting it into carbon dioxide and ethanol.

Figure 4 shows that the highest fat content was found in treatment D at 24.36%, while the lowest fat content was found in treatment A at 22.5%. The fat content of nastar cookies with the addition of giant freshwater prawn shell flour meets the minimum standard set by the Indonesian National Standard (2011) for cookies, which is 18%. The fat content of nastar cookies increased in each treatment. The increase in fat content in nastar cookies is due to the higher fat content in giant freshwater prawn shell flour compared to wheat flour. This indicates that the difference in the concentration of added giant freshwater prawn shell flour significantly affects the fat content of nastar cookies. This is due to the high fat content in the prawn waste flour. Based on dry matter analysis, shrimp waste flour contains 6.62% fat (Poultry Indonesia, 2007). Therefore, the higher the concentration of giant prawn shell flour added, the higher the fat content of the product.

Loss of fat and water content can occur due to protein denaturation in tissues at a level that can cause a decrease in water binding capacity and protein emulsification properties (Pratama *et al.*, 2014).

4. Carbohydrate Content

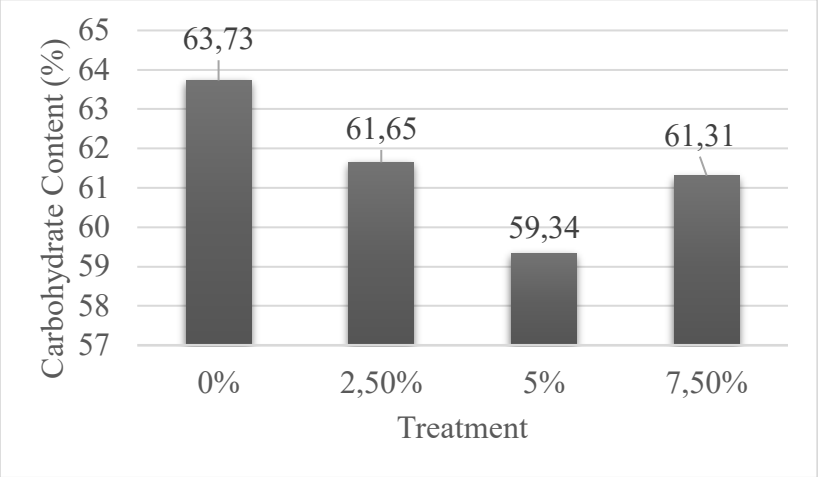

Figure 5. Average Carbohydrate Content

Carbohydrates are compounds formed from carbon, hydrogen, and oxygen molecules. The primary function of carbohydrates is to produce energy for the body. Every gram of carbohydrate consumed produces 4 kcal of energy, and this energy from the oxidation (burning) of carbohydrates is used by the body for functions such as breathing, heart and muscle contractions, and other physical activities (Irawan, 2007).

The carbohydrate content of fishery products is influenced by processing methods, in addition to the initial content of the fish. Carbohydrates can be broken down into simpler compounds. The products of decomposition include glucose, sugar phosphate, pyruvic acid, and lactic acid (Irianto *et al.,* 2009).

The highest carbohydrate content was found in treatment A (63.73%), and the lowest carbohydrate content was found in treatment C (59.34%) (Figure 5). The carbohydrate content of nastar cookies with the addition of giant freshwater prawn shell flour does not meet the quality requirements set by the Indonesian National Standard (2011), which is a minimum of 70%. The carbohydrate content of nastar cookies substituted with giant freshwater prawn shell flour decreased with increasing concentration of giant freshwater prawn shell flour used. This is because the carbohydrate content in prawn shell flour is lower, at 52.74%, compared to the carbohydrate content in wheat flour, at 77.3% (Andriani, 2012).

5. Calcium Content

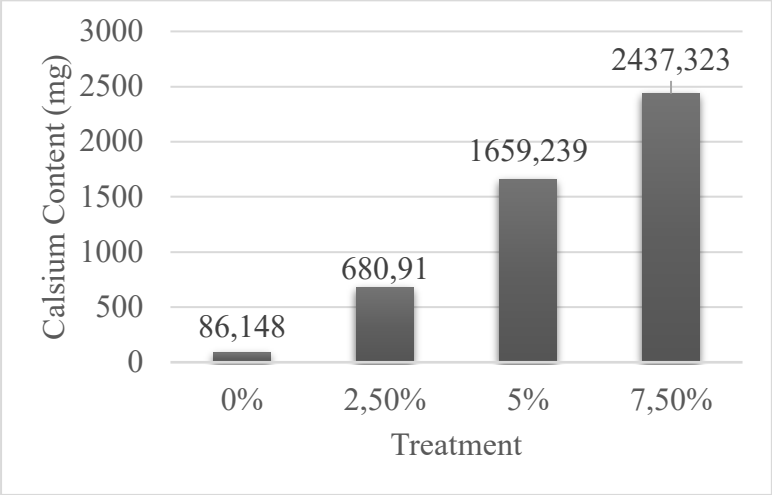

Figure 6. Average Calcium Level

Calcium is a key mineral responsible for bone formation and is also needed to regulate muscle contraction and relaxation, plays a role in nerve transmission, aids in blood clotting, regulates hormones, and acts as a growth factor (Limawan *et al.,* 2015).

Shrimp shell waste contains three main components: 25%-44% protein, 45%-50% calcium carbonate, and 15%-20% chitin (Dompeipen *et al.,* 2016). Calcium carbonate, or CaCO3, is useful as a supplement to increase calcium levels in the body. This compound can also be used as an antacid to treat symptoms of excess stomach acid and reduce high phosphate levels in kidney failure.

The highest calcium content was found in treatment D, which was 2437.323 mg, and the lowest was found in treatment A, which was 86.148 mg (Figure 6). The calcium content of nastar cookies substituting giant prawn shell flour has met the calcium requirement of around 600-1200 mg per day. The calcium content of nastar cookies with giant prawn shell flour substitution increased in each treatment. This is because giant prawn shell flour has a high calcium content, so the more giant prawn shell flour added, the higher the calcium content. This is supported by research by Rtanti *et al,* (2020) on consumer acceptance of cookie products, which shows that there is protein and calcium content with a percentage of shrimp waste flour substitution used of 10%. The difference in calcium content is due to the different calcium content of each ingredient. Mahmud *et al.,* (2009) stated that shrimp flour has a calcium content of 2,360 mg and wheat flour as much as 149 mg.

CONCLUSION

The research results showed that the higher the percentage of shrimp shell flour added to the treatment, the higher the calcium content. The highest calcium content in this study was found in treatment B, with a calcium content of 680.91 mg, which meets the recommended daily calcium intake of 600-1200 mg.

ACKNOWLEDGEMENT

1. Palangka Raya University for its support in implementing the Tri Dharma of Higher Education.
2. The editorial team of the Mataram University Fisheries Journal for their kindness in providing the opportunity to write articles for the Mataram University Fisheries Journal.

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