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Physical Profile of Shrimp Paste (*Mysis relicta*) Powder with Varying Drying Times

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ABSTRACT: Rebon shrimp paste (*Mysis relicta*) is known for its savory taste, high nutritional content, and characteristic reddish-brown color. However, it also has some drawbacks, including inconsistent quality, a semi-wet texture, impracticality in handling, and a relatively short shelf life. To address these issues, one solution is to modify wet shrimp paste into value-added products, such as shrimp paste powder. Shrimp paste powder is produced by drying the paste using an oven at specific temperatures and for varying durations. This study aims to determine the effect of different drying times on the physical, chemical, and sensory characteristics of the powder. Additionally, the study seeks to identify the best treatment based on the drying time that yields the highest quality shrimp paste powder. The study employed a Completely Randomized Design (CRD), with each treatment repeated three times to ensure accuracy. The treatments used in the study were as follows: A1 (oven drying for 5 hours), A2 (oven drying for 6 hours), A3 (oven drying for 7 hours), and A4 (oven drying for 8 hours). The parameters observed in this study included physical analysis of color (lightness, chroma, and hue) and solubility. Based on the research, the best treatment was found to be the A4 treatment (8 hours of drying). The physical analysis of the color of shrimp paste powder showed lightness values ranging from 66.93% to 74.87%, chroma values from 7.89% to 10.54%, and hue values ranging from 6.97° to 21.79°. The solubility analysis results ranged from 62.53% to 66.31%.

KEYWORDS: Oven Drying, Paste Powder, Physical Profile, Rebon Shrimp

INTRODUCTION

One of the marine resource potentials with stable production value is rebon shrimp (*Mysis relicta*). One of the marine resources that has potential with stable production value is rebon shrimp. Rebon shrimp is a marine fishery product that plays an important role in the economic sector for fishermen in Indonesia. It is rich in protein and minerals, and the compounds in rebon shrimp can help prevent osteoporosis, increase HDL (good cholesterol), and reduce LDL (bad cholesterol) and fat levels (Arcika, 2016; Anton et al, 2021). Rebon shrimp, like other types of shrimp, is a rich source of high-quality protein while being low in calories and fat. It also contains significant amounts of essential minerals such as calcium, phosphorus, and potassium, as well as omega-3 fatty acids, which are beneficial for heart health. The nutritional content of 100 grams of fresh rebon shrimp includes Calories: 99 kcal, Protein: 24 g, Total Fat: 0.28 g, Carbohydrates: 0.2 g, Cholesterol: 189 mg, Sodium: 111 mg, Calcium: 70 mg, Iron: 0.51 mg, Magnesium: 39 mg, Phosphorus: 237 mg, and Potassium: 259 mg, Zinc: 1.64 mg (Richardson, 2023). In Indonesia, rebon shrimp is used as a raw material for making Shrimp paste (shrimp paste). The advantage of using rebon shrimp as a raw material is its high nutritional content, unique aroma, savory taste, ease of availability, and higher selling value compared to using fish as a raw material (Kunsah et al., 2021; Sulistiyono et al., 2017).

Shrimp paste is a traditional processed product made through the fermentation process. Fermentation is a biological breakdown process of simple compounds under stable or controlled conditions. In the case of shrimp paste, the fermentation process involves the breakdown of the protein in rebon shrimp into amino acids and peptides. These amino acids then further break down into components that contribute to flavor formation, and the high glutamate amino acid content makes shrimp paste a natural food seasoning (Sumardianto et al. 2019).

Rebon shrimp paste has advantages such as a savory taste, high nutritional content, and a distinctive reddish-brown color. However, it still has some drawbacks, including inconsistent quality, semi-moist texture, impractical packaging, and a relatively short shelf life (Sari et al, 2018; Herlina and Setiarto, 2024). The drying process commonly used by the community is still conventional, relying on sunlight. Although this traditional drying method appears simple and cost-free, it has the drawback of retaining a high moisture content, as the drying time is not consistent due to its dependence on weather conditions. This inconsistency in drying time can lead to variations in the quality of the shrimp paste, highlighting the need for a more controlled drying process.

To address issues of mold growth and short shelf life in shrimp paste, the product can be modified from wet shrimp paste to a value-added product, such as rebon shrimp paste powder. Shrimp paste powder is made by drying it in an oven at specific temperatures and times. Different drying temperatures and times significantly influence shrimp paste's physical and sensory characteristics. Drying is crucial for enhancing flavor, texture, and overall quality. Previous experiments show that varying the drying temperatures and times during the production of shrimp paste results in notable differences in physical attributes (moisture content and color), sensory characteristics (flavor and aroma), texture, and shelf life. (Sari et al. 2018; Sun et al. 2018; Kleekayai et al. 2016; Nevanda. 2023). Based on the issues described, research on using an oven as a drying tool and examining the effects of different drying times is essential. With a controlled drying process, good physical characteristics and high-quality rebon shrimp paste powder are expected to be achieved.

METHODOLOGY

Time and Location Site

The study was conducted from March to June 2024 at the Fisheries Science Laboratory, Faculty of Agriculture, Universitas Sumatera Selatan, Indonesia. Physical analysis testing was conducted at the Agricultural Product Technology Laboratory, Faculty of Agriculture, Universitas Sriwijaya, Indonesia, and Universitas Bengkulu, Indonesia.

Materials and Method

The instrumentation utilized in the experiment comprises processing equipment and laboratory analytical instruments. Processing instruments comprise a blender, stainless steel pan, 60 mesh sieve, oven (blower), spoon, knife, digital scales, plastic clips, and trays. In contrast, physical analysis equipment includes porcelain cups, weighing bottles, glass beakers, Whatman No. 42 filter paper, analytical balance, oven (Memmert), high-quality colorimeter NH310, vacuum pump, measuring cup, stainless spatula, desiccator, clamping pliers, and stainless steel tongs. The primary components for the experiment were moist shrimp paste and distilled water.

The experiment employed a Completely Randomized Design (CRD), with each treatment replicated three times. The treatment comprised four levels: oven drying for 5 hours at 70°C, oven drying for 6 hours at 70°C (A2), oven drying for 7 hours at 70°C (A3), and oven drying for 8 hours at 70°C (A4).

Observed research parameters

Color Analysis

Color analysis measurements were carried out using a high-quality colorimeter NH310. Colors are differentiated based on three values, namely lightness (L), chroma (C), and hue (H).

The color analysis procedure was as follows:

1. The NH310 high-quality colorimeter was turned on, and the button was activated to select the values and numbers used in color analysis. The values used were L (Lightness), C (Chroma), and H (Hue).
2. A rebon shrimp paste powder sample was placed under the lens of the NH310 high-quality colorimeter, and the L, C, and H numbers listed were recorded.
3. The lightness (%), chroma (%), and hue (°) values will indicate the color of the sample, bright and light or dark

Water Solubility Analysis

One gram of rebon shrimp powder was weighed and diluted in 20 ml of distilled water and subsequently filtered through Whatman filter paper no. 42. The sample was subsequently dehydrated and weighed until a stable weight was attained (c). Prior to utilization, the filter paper was subjected to drying in an oven at 105°C for 30 minutes and then weighed (b). After filtration, the filter paper was re-dried in an oven (Memmert) for one hour at 105°C. The filter paper was then cooled.

$$\text{Water solubility (\%)} = 1 - \left(\frac{c-b}{a}\right) x100\%$$

Note:

a = Initial sample weight (g)

b = Weight of filter paper dried (g)

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c = Fixed weight (g) (AOAC, 1995).

Data analysis

The data was analyzed utilizing the SAS (Statistical Analysis System) software, and if a significantly different treatment effect was observed, the Honest Significant Difference (HSD) test was performed.

RESULTS AND DISCUSSION

Color Analysis

Lightness

Lightness is a color attribute determined by incorporating white, which influences the perception of a color's darkness or brightness (Riyadi et al., 2020). The assessment of color value correction (lightness) ranges from 0% for dark color (black) to 100% for light color (white) (Saputra et al., 2016). Figure 1 shows the lightness of rebon shrimp paste powder subjected to varying drying times.

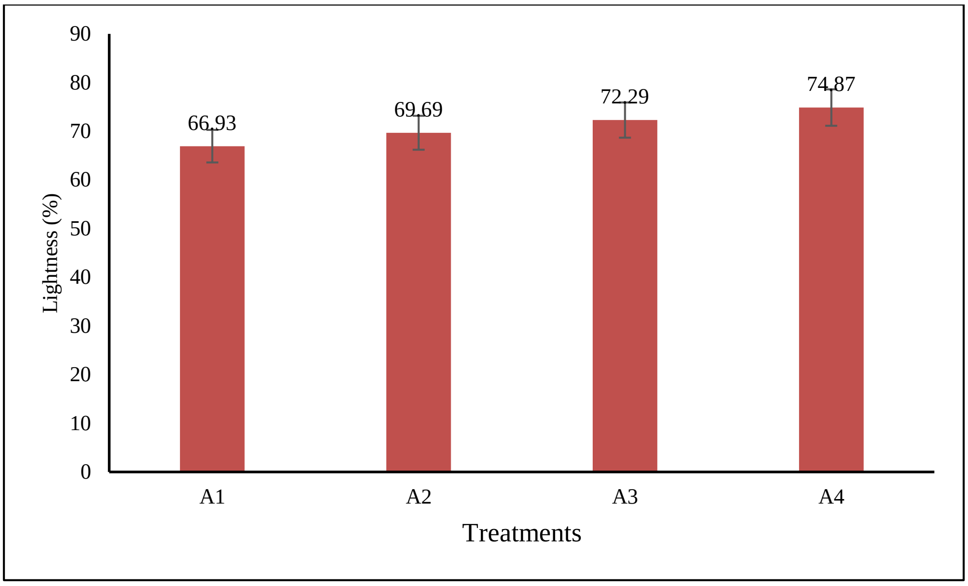

Figure 1. Lightness of rebon shrimp paste (*Mysis relicta*) powder at varying drying times.

Figure 1 shows the brightness of rebon shrimp paste, ranging from 66.93% to 74.87%. The highest value was observed in treatment A4 (8 hours), while the minimum was obtained in treatment A1 (5 hours). This value range indicates a light color (white) exceeding 51%. Lightness values between 51% and 100% indicate color brightness (white), whereas values from 0% to 50% denote darkness (Hunterlab, 2012). An increase in lightness value corresponds to an increase in brightness value (Riyadi et al., 2020). The HSD test results at the 5% significance level indicated that varying the duration of treatment for drying rebon shrimp paste powder significantly influenced lightness levels. Table 1 show the lightness of rebon shrimp paste powder at varying drying times.

Table 1. Lightness of rebon shrimp paste (*Mysis relicta*) powder at varying drying times.

Oven drying at 70^{0}C	Lightness (%)	HSD
A4= 8 hours	74.87	a
A3= 7 hours	72.29	b
A2= 6 hours	69.69	c
A1= 5 hours	66.93	d

The experiment shows that the longer the drying time of shrimp rebon in the oven, the higher the lightness value or the brighter the color. The highest lightness value (74.87) was produced from a drying time of 8 hours, while a drying time of 5 hours resulted in the lowest lightness value (66.93). The relationship between drying periods and the lightness value (brightness) of shrimp

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paste is influenced by several factors, such as moisture content, chemical reactions, and the product's physical properties. As shrimp paste is dried longer, moisture content decreases significantly. Lower moisture levels often correlate with increased lightness in color because moisture can contribute to a darker appearance due to the presence of dissolved organic compounds that may absorb light (Sari et al., 2018; Kleekayai et al., 2016).

Chroma

The chroma value represents the level of color based on intensity and is used to define a product's color brightness, indicating whether it appears glossy or dull. Chroma values range from 0% to 100% (Saputra et al., 2016). A lower chroma value produces a glossier product color, while a higher one results in a duller color (Fiertarico & Harris, 2019). The average chroma values of shrimp paste powder across all treatments are shown in Figure 2.

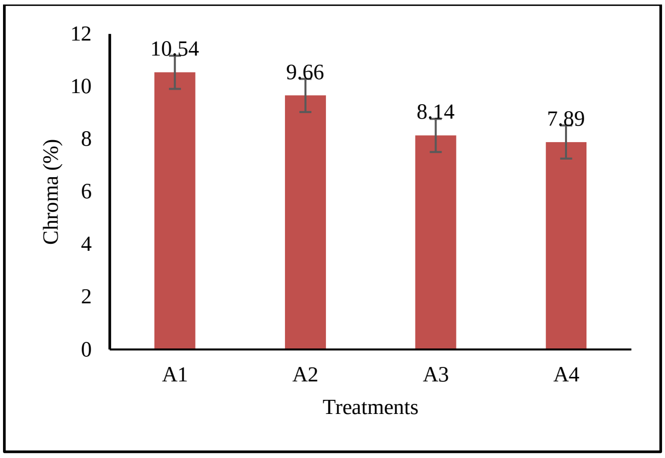

Figure 2. Chroma value of rebon shrimp paste (*Mysis relicta*) powder at varying drying times.

Figure 2 displays the average chroma values of shrimp paste powder, ranging from 7.89% to 10.54%. The highest value, indicating a dull appearance, is found in treatment A1 (5 hours), while the lowest value, indicating a glossy appearance, is in treatment A4 (8 hours). Variations in drying time significantly impact the chroma values of the shrimp paste powder (Table 2).

Table 2. HSD test at 5% level of rebon shrimp paste (*Mysis relicta*) powder chroma value

Oven drying at 70^{0}C	Chroma value (%)	HSD
A1= 5 hours	10.54	a
A2= 6 hours	9.66	ab
A3= 7 hours	8.14	b
A4= 8 hours	7.89	c

Shrimp dried for 8 hours appears glossier than shrimp dried for 7, 6, or 5 hours. The 5-hour drying time results in the dullest color, with a chroma value of 10.54, although this is not significantly different from the 6-hour drying time, which has a chroma value 9.66. This dulling effect occurs because the shrimp, which serves as the raw material for the paste, contains carbohydrates and proteins that undergo non-enzymatic browning when heated. The heat during drying triggers a Maillard reaction between amino acids and reducing sugars. This reaction produces brown melanoidin compounds, which can reduce the brightness of a product's appearance (Fiertarico & Harris, 2019), resulting in a darker or less vibrant product.

Hue

Hue is a value that determines the dominant color of a product, whether it tends toward green, yellow, or red (Riyadi et al., 2020). Hue serves as an indicator of the product's color, with its range presented in Table 3. Table 3 illustrates that different intensities of hue values produce different colors. Higher hue values indicate a tendency toward blue to purple, while lower hue values indicate a tendency toward green to red.

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Table 3. Hue value Criteria and range

Hue value criteria	Hue range (°)
Red Purple (RP)	342 - 18
Red (R)	18 - 54
Yellow Red (YR)	54 - 90
Yellow-green (Y)	90 - 126
Green (G)	126- 198
Blue Green (BG)	198 - 234
Blue (B)	234 - 270
Purple (BP)	270 - 306
BluePurple (P)	306 -342

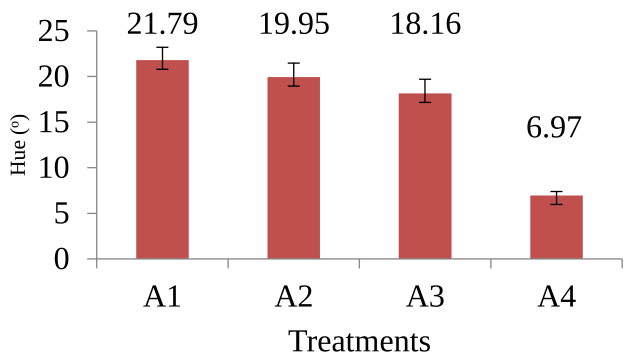

Figure 3. Hue value of rebon shrimp paste (*Mysis relicta*) powder at varying drying times.

Table 3 shows that the hue values of shrimp paste powder range from 6.97% to 21.79%. The highest hue value was observed with the 5-hour drying treatment (21.79°), while the lowest was found with the 8-hour treatment (6.97°). According to Table 3, the hue values for the 5, 6, and 7-hour drying treatments (A1, A2, A3) fall within the "red" category, while the 8-hour drying treatment (A4) does not meet the established criteria. This is likely because the prolonged drying time of 8 hours in A4 caused excessive oxidation of pigments, leading to browning (Sari et al., 2019a). Additionally, processing conditions can impact various components (Sari et al., 2022). The color change in shrimp paste powder is also influenced by the Maillard reaction induced by heating.

Table 4 show the hue value of shrimp paste powder across different drying times. The highest Hue value was obtained from the treatment A1 (drying duration of 5 hours), followed by drying durations of 6 and 7 hours. The drying duration of 8 hours (A4) resulted in the lowest Hue value (6.97).

Table 3. HSD test at 5% level of rebon shrimp paste (*Mysis relicta*) powder hue value.

Oven drying at 70°C	Hue value (°)	HSD
A1= 5 hours	21.79	a
A2= 6 hours	19.95	ab
A3= 7 hours	18.16	b
A4= 8 hours	6.97	c

Drying durations of shrimp paste powder is in the range of 5 to 7 hours produced Hue values between 18.16 and 21.79, which fall within the "red" criteria. The Hue value of 18.16 to 21.79 pertain to the color measurement of the shrimp paste powder, which is a critical quality parameter. The color can influence consumer acceptance and perception of freshness. The "red" criteria typically indicate a desirable color for shrimp paste, aligning with consumer expectations (Sari et al. 2024). The relationship between drying

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time and Hue values indicates that ideal drying conditions not only ensure safety by lowering microbial levels but also enhance the visual quality of the shrimp paste powder. Achieving this balance is crucial for producers who strive to meet both market standards and consumer expectations. (Sari et al. 2018; Ajifolokun et al. 2018).

Solubility Analysis

Solubility is defined as the maximum amount of a solute that can dissolve in a given solvent to form a homogeneous solution. One factor that affects dissolution time is moisture content; the higher the moisture content, the longer it takes to dissolve (Adhayanti & Ahmad, 2021; Sari et al., 2017). Factors that influence water content are the weight of the material and drying time (Mandati et al. 2022). Increased moisture content leads to bonds that create clumping, making it take longer to break down the bonds between particles (Adhayanti & Ahmad, 2021). Figure 4 shows the average solubility analysis results for shrimp paste powder across all treatments.

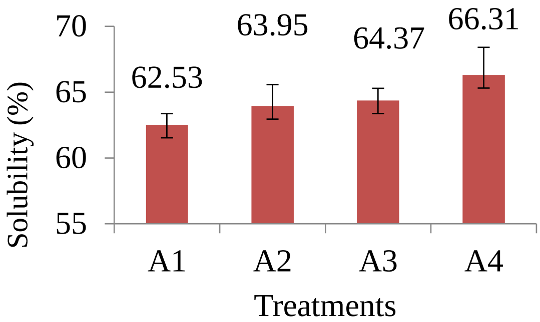

Figure 4. Solubility of rebon shrimp paste (*Mysis relicta*) powder with different drying times.

According to Figure 4, the test results show that the average solubility value of shrimp paste powder ranges from 62.53% to 66.37%. The highest value was obtained in treatment A4 (8 hours), while the lowest was found in treatment A1 (5 hours). The solubility value increases with longer drying times. This increase in drying time reduces the moisture content in the material, making it more hygroscopic and more accessible to absorb water, thereby enhancing solubility (Ajifolokun et al. 2018). The higher the solubility value of a material, the faster it dissolves in water (Kim et al., 2014). Table 4 show the effect of varying drying times on shrimp paste powder on solubility.

Table 4. HSD test at 5% level of rebon shrimp paste (*Mysis relicta*) powder solubility.

Oven drying at 70^0C	Solubility	HSD
A4= 8 hours	66.31	a
A3= 7 hours	64.37	ab
A2= 6 hours	63.95	ab
A1= 5 hours	62.53	b

It is assumed that the 8-hour drying time results in lower moisture content, leading to increased solubility of the shrimp paste powder. Reducing moisture content is crucial for extending shelf life and preventing microbial growth that can spoil the product. The low water activity (Aw) in shrimp paste enhances its shelf life by inhibiting microbial spoilage. This limits the growth of foodborne pathogens, contributing to the product's long-term stability (Kim et al. 2014; Daroonpunt et al, 2016). Research indicates that longer drying times generally correlate with lower moisture levels, which is beneficial for food safety and quality (Sari et al. 2024). By extending the drying time to 8 hours, the reduced moisture content allows the powder to dissolve more readily, which can improve its consistency, usability in cooking or food processing, and overall effectiveness in dishes. Enhanced solubility can be especially important for consumer satisfaction and for meeting industry standards where ease of mixing and uniformity in recipes are desired.

CONCLUSIONS

Based on this study, the optimal treatment was drying shrimp paste powder (*Mysis relicta*) at 70^0 C for 8 hours. The physical color analysis of the shrimp paste powder showed a lightness range of 66.93% to 74.87%, a chroma range of 7.89% to 10.54%, a hue average range of 6.97º to 21.79º, and solubility analysis results ranging from 62.53% to 66.31%. This research implies that optimizing drying time and conditions can improve the quality, consistency, and shelf life of shrimp paste powder, making it more practical for storage and use. In addition to drying duration, temperature also affects the physical and chemical properties of shrimp paste powder, so further research could explore temperature and time combinations to determine the optimal conditions that produce the best quality.

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