

Quality changes on petis rempah during storage

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Received: 11 November 2022

Received in revised form: 29

June 2023

Accepted: 27 September 2023

Available Online: 31 October

2023

Keywords:

Shrimp,

Spices,

Petis,

Storage,

Quality

DOI:[https://doi.org/10.26656/fr.2017.7\(S3\).4](https://doi.org/10.26656/fr.2017.7(S3).4)**Abstract**

Petis is a component in Indonesian and Malay cuisine made from the byproduct of processing pindang which is heated until the liquid becomes thick like a more concentrated sauce. Petis is usually used as a food seasoning. Petis usually have a very strong aroma and taste so they usually need to be reseasoned before consumption. Currently on the market, petis products are developing to be ready to eat product with the addition of spices. The purpose of this study was to determine the quality changes of petis rempah (spices petis) on the chemical characteristics (aw, pH, proximate, total acid and TVBN), physical characteristics (viscosity and color), microbiological characteristics (TPC), and sensory of petis during storage in room temperature (weeks 0, 1, 2, 3 and 4). The basic design used in this study was a completely randomized design. Data were analyzed using ANOVA and if significantly different, further tested using HSD. The data from this study showed that the longer the storage time, the lower the quality of the spice paste. The spice paste was rejected by consumers in the third week of storage. Storage time for 3 weeks showed a decrease in quality based on the average value of the parameters tested. Aw has a stable value at 0.8-0.9. pH decreased from 7.25 to 6.73. The water content increased from 39.49% to 43.91%, the protein content decreased from 8.02% to 7.24%. Total acid increased from 0.51% to 0.98%. TVBN increased from 16.18 mg/100 g to 24.82 mg/100 g. Viscosity decreased from 166019.67 cp to 128847.00 cp. Colors experience a decrease in both L*, a *, and b * values. TPC increased from 2.93 CFU/g to 3.50 CFU/g, and sensory decreased from 8.60 to 6.89. Storage for 4 weeks showed a decrease in the quality of the spice paste.

1. Introduction

Indonesia is a maritime country that has quite large fishery potential, one of which is shrimp production. Based on data from the Ministry of Marine Affairs and Fisheries in 2020, total shrimp production reached 434,872.72 tons. Shrimp is an aquatic biota that can live in marine, fresh and brackish waters (Collins, 1998). Shrimp has a high protein content so that it can meet daily nutritional needs. From this, many shrimp farmers in Indonesia cultivate because they have a high selling value (Said and Nina, 2018). In the Malahayu reservoir area, Central Java, shrimp is one of the livelihoods of coastal communities for sale and private consumption (Said *et al.*, 2014). Availability of abundant shrimp, must be handled quickly to minimize the occurrence of quality loss. One of the traditional methods of processing shrimp is making shrimp paste.

Petis is a traditional fishery product in the form of pasta. Petis is similar to oyster sauce. Oyster sauce made by boiling the oyster for hour then the water dried in the sun until it thickens (Yu *et al.*, 2022).

Petis is made from fish or shrimp boiled water with the addition of sugar, salt and fillers. Petis is quite in demand by the public because it has a savory, salty and sweet taste. The appearance of the shrimp paste is blackish brown, this depends on the type of raw material used. Petis is usually used as a condiment or an alternative ingredient in cooking. According to Wahdiniati *et al.* (2016), petis is used as a mixture of natural cooking spices. Petis are usually distributed in the form of additional ingredients or in rujak seasoning, be it lontong salad, fruit salad, and rujak with crackers. Shrimp paste contains nutrients including 0.2% fat, 24% carbohydrates, 151.0 kcal energy, 56.0% water, 37 mg

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calcium, 36 mg phosphorus, 2.8 mg iron, and minerals (vitamin A, B1 and C) (Naqsyabandi *et al.*, 2022). Based on the results of research from Sari *et al.* (2021), petis from the stew of scad fish has a white degree of 40.49-45.50% with a viscosity of 568.75-981.25 dPa's.

Making petis with the addition of herbs and spices is useful for improving the quality of shrimp paste. The addition of brown sugar will affect the color. The use of filler material will also affect the resulting petis. The addition of flour with a high concentration can reduce the savory taste of the petis. To improve the character of the petis, it is necessary to add spices, such as lemongrass and garlic (Mumtazah *et al.*, 2021). Other spices that can be added to the shrimp paste include red onion, laos, ginger, kaffir lime leaves and bay leaves. Spices in addition to providing a distinctive taste and aroma also function as food preservatives. According to Tanuwijaya and Angelica (2021), spices become kitchen ingredients that are useful for creating delicious and nutritious food. Spices produce a distinctive aroma and color, prevent spoilage and act as natural preservatives in food.

Food quality during storage at room temperature will continue to decline. Likewise with the shrimp paste. The decrease in the quality of shrimp paste is related to changes in microbiological, physical and chemical characters. Factors that affect during storage include temperature, humidity, air and light. Damage that may occur are protein damage, changes in odor, changes in organoleptic elements, lipid oxidation, vitamin damage, to the formation of toxins (Archadiya *et al.*, 2021). Based on this, it is necessary to conduct research that aims to determine changes in the quality of spice paste on chemical, physical, microbiological, and sensory properties during storage at room temperature.

2. Materials and methods

2.1 Production

Petis obtained from Raja Udang Sidoarjo, East Java is reprocessed into a petis rempah. The making of petis rempah requires spices consisting of 5 grams of salt, 8 grams of brown sugar, 50 grams of garlic, 50 grams of red onion, 3 stalks of lemongrass, 2.5 grams of MSG, and 150 mL of ginger acid, which were mixed and mashed. The spices that have been mashed and become spices are sauteed and cooked together with the petis for 10 mins. Petis that has been cooked together with the spices is called the petis rempah and kept in a container and sealed.

2.2 Storage

Petis rempah were put in a sealed plastic bottle, then

stored for 4 weeks in closed conditions at room temperature. During storage, observations were made every week (0,1, 2, 3 and 4 weeks).

2.3 Analysis

2.3.1 Activity water

The aw test is carried out based on the method described by Saenab (2010) by placing the available sample into a special tube. The aw meter is then inserted into the tube, placing the tube in the container provided. The screen of the tool will show the progress of the measurement. The measurement process is complete when the value on the screen stops.

2.3.2 Water content

The water content analysis was carried out (AOAC, 1970) by weighing the sample (1-2 g) and then drying it in an oven. Drying is carried out for 3-5 hrs at a temperature of 100-105⁰C. Then cooled in a desiccator and weighed, then heated again in the oven for 30 mins, cooled, and weighed. This treatment was repeated until a constant weight was reached.

$$\% \text{ Water content} = \frac{B - C}{B - A} \times 100\%$$

Where A: Weight of the cup (g), B: Weight (cup+sample) before drying (g), and C: Weight (cup+sample) after drying (grams)

2.3.3 Protein content

Protein content analysis (BSN, 2006) was carried out using the Kjeldhal method. This method consists of three stages, destruction, distillation and titration. The sample (2 g) was put into the destruction flask. Then, 2 tablets of 15 mL concentrated H₂SO₄ catalyst and H₂O₂ were added slowly and allowed to stand for 10 mins in the acid chamber. Destruction was carried out at 410⁰C for 2 hrs or until the solution was clear and allowed to stand until it reached room temperature and 50-75 mL of distilled water was added. 4% H₃BO₃ solution containing indicator was prepared in Erlenmeyer as a distillate container. The flask containing the results of the destruction is installed in a series of steam distillation apparatuses. Then 50-75 mL of sodium hydroxide-thiosulfate solution was added. Distillation is carried out by holding the distillate up to a minimum volume of 150 mL (the distillation result will turn yellow). The distillate was titrated with 0.2 N HCl until the color changed from green to neutral gray.

$$\% \text{ Protein Content} = \frac{(\text{mL HCl sample titration} - \text{mL HCl blank titration}) \times \text{N HCl} \times 14.007 \times 6.25}{\text{sample weight} \times 100} \times 100\%$$

2.3.4 pH

The pH test was carried out using a pH meter (AOAC, 1990). The pH meter electrode was calibrated using a buffer solution of pH 4.31 and 6.86, then rinsed

with distilled water and dried with a tissue. The electrode is inserted into the sample solution after which the result of the pH value appears on the display screen. Logging is done at the value after the constant.

2.3.5 Total acid

The total acid was calculated by the titration method (Apriyantono, 1989). The weighed sample was put into a 250 mL Erlenmeyer, then diluted using a 250 mL volumetric flask. A 25 mL of the solution was added with phenolphthalein indicator, then titrated using a standard solution of 0.1 N NaOH until the color changes to pink and the calculation is carried out with the following formula:

$$\% \text{ Total Acid} = \frac{\text{titration volume} \times \text{fp} \times \text{normalitas NaOH} \times \text{acid molecular weight}}{\text{sample weight (mg)}} \times 100 \%$$

2.3.6 Total volatile base nitrogen

The TVBN test refers to BSN (2009) using the BCG-MR indicator. Five grams sample was put into an Erlenmeyer flask followed by 25 mL of 5% TCA. Then 20 mL of Na-thiosulfate (40% NaOH+5% Na₂S₂O₃) was added and the distillation was carried out in distillate container using 5% H₃BO₃ with BCG-MR indicator. Collect 60 mL of the distillate and titrate using 0.02 N HCl.

$$\text{TVBN (mg/100 g)} = \frac{\text{titrated volume (V1)} \times \text{N.HCl} \times \text{BA Nitrogen (14.008)} \times \text{fp}}{\text{sample weight (g)}} \times 100$$

2.3.7 Viscosity

Viscosity was measured using a Brookfield Viscometer (Naiu and Yusuf, 2018). The first step is that the spindle is first cleaned and then heated at a temperature of 75°C and then attached to the Brookfield Viscometer measuring instrument. The position of the spindle in the hot solution is adjusted to the right, then the viscometer is turned on and the temperature of the solution is measured. When the temperature of the solution reached 75°C, the thermometer is removed and the viscosity value is known by reading the viscometer on a scale of 1 to 100. The reading of the instrument is done after one minute of a full rotation. The readings are duplicated according to the spindle used at a speed of 60 rpm. This is to express absolute viscosity in units of centipoise (cP).

2.3.8 Color

Color analysis was carried out using a Konica Minolta CR 410 chromameter (Hasan et al., 2022). The instrument was cleaned with a soft cloth and a little water to dry, then the instrument was calibrated by pressing the call button and making sure the calibration number was the same as that on the white plate. Place the CR head on the white plate and press enter. The device will read three times until it beeps. The sample is inserted in the white plate, enter then the results will

appear. The numbers read are then used for statistical analysis.

2.3.9 Total plate count

The principle of the total plate count (TPC) method is that sample in serial dilution poured on PCA (pour plate) media and incubated at 37°C. The number of colonies in three highest dilution was used to calculate the estimated number of microorganisms present in the sample (Fardiaz, 1992).

2.3.10 Sensory evaluation

This sensory test refers to BSN (2011), to determine the level of quality based on a scale of number 1 as the lowest score and number 9 as the highest score by using an assessment sheet. The results of the test descriptions of each panelist on the scoring sheet were compiled and analyzed to form a conclusion on the specifications for appearance, smell, taste, consistency, and other specifications.

3. Results and discussion

3.1 Chemical characteristics

3.1.1 Water activity

The aw data shown in Table 1 with value ranging from 0.8 to 0.9 were not significantly different. This phenomenon may be because the storage time is not too long and product is well packaged (Rianingsih et al. 2021). Aw play important role in microorganism. Each microorganism has different aw optimum for their optimum growth. Bacteria need higher aw for their growth than fungi/mold. According to Ndahawali (2016), mold usually grows on aw approximately 0.8. The aw of this petis product is still quite high, allowing t microorganism that will cause a decline in product quality and the shelf life of the product will be short.

3.1.2 Water content

Water content of petis rempah was shown in Table 1. The data range from 39.49% to 46.5%. Water content of petis rempah increased during storage. According to Solihin et al. (2015), the treatment of long storage time affects the value of the water content of a product. The longer the storage, the water content will continue to increase. This is confirmed by Sakti et al. (2016), who reported that the increase in the water content of a product is influenced by the humidity at room temperature. Higher air humidity causes the water vapor content in the product to be more and more so that the water content increases, with a high water content the food product will be easily damage.

3.1.3 Protein content

Protein content of petis rempah gradually decreased

Table 1. Storage time on chemical characteristics.

Storage Time	Water activity	Water Content (%)	Protein Content (%)	pH	Total Acid (%)	TVBN (mg/100 g)
Week 0	0.82±0.01 ^a	39.49±1.18 ^a	8.02±0.21 ^c	7.25±0.03 ^d	0.51±0.006 ^a	16.18±2.07 ^a
Week 1	0.85±0.01 ^a	42.44±0.95 ^{ab}	7.71±0.14 ^{bc}	7.08±0.06 ^c	0.65±0.06 ^{ab}	20.96±3.26 ^{ab}
Week 2	0.83±0.02 ^a	42.90±0.75 ^{ab}	7.41±0.07 ^{ab}	6.85±0.06 ^b	0.84±0.05 ^{bc}	23.99±0.73 ^b
Week 3	0.85±0.01 ^a	43.91±3.44 ^{ab}	7.24±0.06 ^a	6.73±0.06 ^b	0.98±0.06 ^{cd}	24.48±0.20 ^{bc}
Week 4	0.84±0.01 ^a	46.50±0.12 ^b	7.19±0.12 ^a	6.55±0.09 ^a	1.13±0.12 ^d	28.82±0.68 ^c

Values are presented as mean±SD of three replicates. Values with different superscripts within the same column are statistically significantly different ($p < 0.05$).

from 8.02% to 7.19% during storage (Table 1). Protein content was in contrast with TVB data. This phenomenon was probably caused by microorganism growth (Che *et al.*, 2021). Microorganism need protein for growth. Some of putrefactive bacteria will metabolize protein and produce some volatile base compound. The longer storage time will result in lower protein content because it was used by the microorganisms and produce volatile base compound which contribute to increase in the TVB value (Table 1). Besides that, according to Pramuditya and Sudarminto (2014), a decrease in protein can occur due to an increase in the water content in food. The amount of water will reduce the percentage of protein content.

3.1.4 pH

The pH value of petis product decreased during storage from 7.25 to 6.55. The results of the study are shown in Table 1. During storage product will deteriorate and marked with the changes of pH value. According to Putra *et al.* (2014), the pH value will change during storage. This indicates a reaction or damage to the components that make up the food. According to Li *et al.* (2020), the pH value can cause the protein structure to change and hydrolysis to occur. Damaged protein structures due to changes in pH can trigger organic compounds to liberate bound water into free water which is also associated with an increase in water content during storage.

3.1.5 Total acid

Total acid in sample petis was increase during storage (Table 1). The increase in total acid was associated with a decrease in pH value. During storage, microorganisms will grow and convert organic compounds into various other compounds, including acids, which will eventually lower the pH value. The more acid formed will result in the lower pH of the sample. According to Aditiwati (2003), the increase of microorganisms occurred after two days, due to the availability of nutrients and a suitable pH for the growth of microorganisms.

3.1.6 Total volatile base nitrogen

Table 1 shows that there is an increase in the value of TVBN every week. This shows that there is spoilage microbial activity during storage (Gao *et al.*, 2022). The increase in the value of TVB is the result of protein decomposition by bacterial activity by means of protein breakdown. The breakdown of protein produces ammonia and CO₂, besides that the breakdown of protein also becomes non-protein N. The results of protein breakdown also cause a foul odor caused by ammonia and H₂S. Based on the TVB test, the spiced petis is still suitable for consumption from the first week to the last week, this is because the TVB value of the petis is still below 30 mgN/100 g. According to Rahmah *et al.* (2020), during the process of decreasing the quality of fish, protein is broken down by decaying bacteria into simpler nitrogen compounds such as trimethylamine, dimethylamine, and ammonia as well as other odorous compounds such as ketone acids which will then turn into aldehydes and ketones. TVB is an indicator of deterioration in the quality of fishery products. The limits for TVB levels in fishery products is TVB 30 mgN/100 g. Fish are considered as fresh when TVB values are $10 \leq \text{TVB} \leq 20$ mgN/100 g. Thus, fish that is still fit for consumption has TVB value of $20 \leq \text{TVB} \leq 30$ mgN/100 g, whereas fish that are not fit for consumption because its rotten have TVB value of >30 mgN/100 g).

3.2 Physical and microbiology characteristics

3.2.1 Viscosity

Viscosity of petis is shown in Table 2. During storage, the viscosity of petis was decreased from 166,019.67 cp to 118,218.00 cp at the end of the storage time. The thickness of the paste product is caused by the reduced water content during processing. In addition, some processors add flour fillers which will cause the paste product to thicken (Alam *et al.* 2021). During storage, the viscosity of the paste decreased as the water content increased. The increasing of water content can affect the viscosity of the product. According to Apriliani *et al.* (2019), the addition of flour filler also has an effect. Flour contains starch which is able to bind more free water so that the thicker the paste, the higher the viscosity value. During storage, several chemical

reactions occur, for example the breakdown of proteins and other organic compounds, thereby increasing the free water of the product and reducing the viscosity of the paste product.

3.2.2 Color

Data on the color analysis of petis was shown in Table 2. During storage, the L* value increased from 26.46 to 28.40, the a* value decreased from 2.37 to 1.54, and the b* value increased from 3.10 to 3.71. Based on the L* value, the color of the petis tends to be darker. The dark color is influenced by the caramelization reaction and the maillard reaction. According to Kuncoro *et al.* (2019), the occurrence of caramelization and maillard reactions is due to the addition of brown sugar in the petis which was cooked for a long time, the presence of protein and reducing sugar, and the heat. Based on a* value, the petis is reddish in color. According to Sari and Joni (2015), the reddish color of instant petis with the addition of wheat flour and tapioca produces petis with a higher level of redness. Based on the value of b*, the spice paste is dark yellow in color. According to Sari *et al.* (2021), the lower the yellowness of the product, the more tapioca flour was added. The level of yellowness of the filler material affects the final product.

3.2.3. Total plate count

Table 2 shows the results of the TPC value that continues to increase, this shows that every week there is microbial growth in the spice paste. According to Chorina (2016), storage time will affect the number of microorganisms, especially molds found in food. The longer the storage, the more mold will grow, so the TPC value obtained will increase. The increase in the TPC

value every week can also be caused by processing, the availability of oxygen in food, and the nutritional content of foodstuffs.

3.3 Sensory evaluation

Table 3 shows the results that the parameter values of appearance, smell, taste, and consistency have decreased in quality every week. Each parameter experienced a significant decrease at week 3. At week 3, petis was not suitable for consumption because the average results were below the standard.

4. Conclusion

Petis is usually used as a spice in cooking. Petis usually have a very strong aroma and taste so they usually need to be reseasoned before consumption. Currently, on the market, petis products have developed into ready to eat products with additional spices called petis rempah. Petis rempah deteriorate during storage. Based on tests conducted on this research, petis rempah has been rejected after 3 weeks storage in room temperature with the final result of 0.85 aw, pH 6.73, 43.91% water content, 7.24% protein content, 0.98% total acid, 24.82 mg/100 g TVBN and viscosity of 128847.00 cp.

Acknowledgements

This research was funded by Faculty of Fisheries and Marine Sciences, Diponegoro University, Year 2022.

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Table 2. Storage time on physical and microbiology characteristics.

Storage Time	Viscosity	Color			TPC
		L*	a*	b*	
Week 0	166019.67±19828.50 ^b	24.46±1.06 ^a	2.37±0.15 ^b	3.10±0.05 ^a	2.93±0.10 ^a
Week 1	150610.67±18034.76 ^{ab}	28.52±0.23 ^{ab}	1.68±0.30 ^{ab}	3.91±0.48 ^a	3.15±0.05 ^b
Week 2	136883.33±8363.37 ^{ab}	29.36±0.65 ^b	1.61±0.30 ^{ab}	3.37±0.54 ^a	3.28±0.02 ^{bc}
Week 3	128847.00±6122.68 ^a	29.05±1.20 ^b	1.62±0.08 ^{ab}	3.32±0.81 ^a	3.37±0.03 ^{cd}
Week 4	118218.00±3916.86 ^a	28.40±0.81 ^{ab}	1.54±0.46 ^a	3.71±0.25 ^a	3.50±0.05 ^d

Values are presented as mean±SD of three replicates. Values with different superscripts within the same column are statistically significantly different (p<0.05).

Table 3. Storage time on sensory characteristics.

Storage time	Appearance	Smell	Taste	Consistency
Week 0	9.00±0.000 ^a	8.77±0.646 ^a	8.49±0.887 ^a	7.97±1.014 ^a
Week 1	8.66±0.765 ^b	8.60±0.812 ^{ab}	8.43±0.917 ^a	7.97±1.014 ^a
Week 2	8.37±0.942 ^{bc}	8.20±0.994 ^b	8.26±0.980 ^a	7.86±1.004 ^a
Week 3	8.20±0.994 ^c	6.14±1.216 ^d	5.86±1.309 ^{bc}	7.57±0.917 ^a
Week 4	8.03±1.483 ^d	3.51±1.401 ^a	5.57±1.243 ^c	5.46±1.821 ^b

Values are presented as mean±SD of three replicates. Values with different superscripts within the same column are statistically significantly different (p<0.05).

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