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# The Effect of Packaging Type and Storage Duration on the Chemical and Sensory Properties of Tilapia Floss

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***ABSTRACT***

*Tilapia floss is one of the main products of Poklahsar Bunda Madani Panembangan. The choice of packaging type is critical so that the quality of tilapia floss can be maintained during storage. This study aims to determine the effect of packaging type and storage duration on tilapia floss's chemical and sensory properties. This study used a factorial Completely Randomized Design. Factors such as kraft paper and polypropylene (PP) plastic packaging. The storage time factor consists of 4 levels, namely 0, 25, 50, and 75 days of storage. Data from the research were analyzed statistically with SPSS application, for chemical variables (moisture content and TBA value) analyzed using variance analysis and continued with Duncan's Multiple Range Test (DMRT), and sensory variable data (appearance, aroma, taste, and texture) analyzed using Friedman's test. The results showed that PP plastic was better than kraft paper based on the chemical variables, and the effect was no different from sensory variables. Long storage has an effect on increasing water content and TBA value, as well as reducing floss sensory. Using PP plastic gave better results than kraft packaging based on the water content, TBA value, and sensory value of tilapia floss during 75 days of storage.*

**Keywords**: *floss, packaging, storage*

## INTRODUCTION

Panembangan Village, Cilongok District, Banyumas was selected by the Ministry of Marine Affairs and Fisheries (KKP) as a pioneer village for Smart Fisheries Village (SFV) in Indonesia (Pramono *et al* ., 2022). Poklahsar is one example of the Smart Fisheries Village (SFV) program. Based on the Regulation of the Minister of Marine Affairs and Fisheries No. 2 of 2013, it is explained that Poklahsar is a collection of processors and/or marketers of fishery products who carry out business activities in the field of processing and marketing fishery products together in a group (Efani *et al* ., 2022). One of the active Poklahsar is the Bunda Madani Poklahsar, where they are active in processing and marketing tilapia-based food products. Tilapia floss is one of Poklahsar Bunda Madani's products.

Fish floss is a preserved food from seasoned fish processed by boiling, frying, pressing, or separating the oil (Anwar *et al* ., 2018). The frying process is usually done by deep frying so that the oil content in the floss becomes high. Therefore, pressing is done to reduce the oil content in the floss. However, not all the oil content comes out even though pressing is done (Anggo *et al* ., 2018). Fish floss will experience a decrease in quality due to chemical and physical changes that occur in the floss during storage (Polutu *et al* ., 2015). Sudarmadji *et al* . (2003) stated that food products containing fat or oil usually experience a rancidity process during storage. Rancidity is the process of fat damage that causes the taste and smell of the product to be unpleasant. Oxidation reactions and changes in the structure of the fat components cause this rancidity. Other quality changes can be seen

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from the sensory properties, such as the texture of the floss that clumps and the non-specific taste of fish floss.

Packaging is needed so that products such as fish floss can be stored for a long time. The type of packaging will affect the quality of fish floss during storage. As in the study by Jayadi *et al* . (2016), different types of packaging will affect the quality of flying fish floss. Therefore, the type of inappropriate product packaging can cause a decrease in the quality of the food product, so the type of packaging material must be adjusted to the product's characteristics. The packaging that can be used for tilapia fish floss is made of kraft paper and polypropylene (PP) plastic. The advantages of kraft paper packaging are that it is flexible and popular, is easy to recycle, is food grade, and is safe for health (Zunaidi *et al* ., 2023). The advantages of PP plastic are that it has stiff, strong and light properties than polyethylene with low water vapor permeability, has good resistance to fat, is stable at high temperatures and is shiny, can prevent chemical reactions and has heat-resistant properties.

Based on research by Polutu *et al*. (2015), the type of packaging and storage time significantly affect the quality of eel floss. Based on the two types of packaging to be studied, the best packaging that can be used to maintain the quality of tilapia floss is not yet known. Therefore, through this study, it is expected that the type of packaging will be obtained, that is, by the characteristics of tilapia floss, so that the product quality can be maintained longer. If the product's shelf life is longer, the tilapia floss can be marketed more widely.

In addition, based on research conducted by Alamri *et al*. (2021), food packaging protects food from various physical, chemical, and microbiological hazards that can affect the quality and safety of food products. Packaging functions to prevent contamination from hazardous chemicals, microorganisms, and other environmental factors that can damage food. One of the goals is to extend the shelf life of food, maintain freshness, and increase consumer comfort with guaranteed food safety.

## METHODS

### *Material*

The primary material used is tilapia fish floss with the species *Oreochromis niloticus* produced by the Bunda Madani processing and marketing group (Poklahsar). The chemical analysis materials used include HCl 4 M, 2-thiobarbituric acid (TBA) solution with a concentration of 0.02 M in 90% glacial acetic acid, and distilled water.

### *Equipment*

The equipment used includes porcelain cups, analytical scales, ovens, desiccators, pipettes, measuring cups, distillation apparatus, Erlenmeyer flasks, beakers, blenders, test tubes, spectrophotometry, vortex apparatus, and hot plates.

### *Research Design*

The research was conducted for 7 months, from December 2023 to June 2024, at the Agricultural Technology Laboratory of Jenderal Soedirman University, Purwokerto. The first stage is making tilapia fish floss. The preparation of tilapia floss began with selecting fresh tilapia fish as the main raw material. The fish were cleaned by removing the scales, skin, and other impurities, then steamed until fully cooked. Once cooked, the flesh was separated manually from the bones and skin, and then shredded into fine fibers. The seasoning ingredients, consisting of shallots, garlic, coriander, salt, and galangal, were ground into a smooth paste. The shredded fish was then mixed with the ground spices and cooked until the mixture was well blended. During the cooking process, additional flavoring ingredients—granulated sugar, bay leaves, lemongrass, and kaffir lime leaves—were added to enhance the taste and aroma. Following the cooking process, the seasoned fish mixture was deep-fried while continuously stirred until it became dry and turned golden brown. The fried tilapia floss was then subjected to oil reduction using a spinner machine for 2 minutes to remove excess oil. The final product, tilapia floss, was then ready for packaging in airtight containers to maintain its quality and shelf life. Tilapia fish floss is packaged in kraft paper and PP plastic and stored for 75 days at room temperature.

This study employed an experimental approach utilizing a factorial design with a Completely Randomized Design (CRD). The factors evaluated in the study included packaging type (P) and storage duration (L). Packaging type (P) consisted of P1 = kraft paper and P2 = polypropylene (PP) plastic. Storage duration (L) is comprised of four levels: L1 = 0 days, L2 = 25 days, L3 = 50 days, and L4 = 75 days. A total of eight treatment combinations were derived from the factorial design. Each treatment combination was repeated three times, resulting in 24 experimental units.

***Test Parameters***

The product analysis included chemical and sensory analysis. Chemical analysis includes water content (AOAC, 2005) Water content was quantified using a thermogravimetric approach, as described in AOAC (2005). An empty porcelain crucible was pre-conditioned in an oven at 100 °C for 15 min, cooled to room temperature in a desiccator, and weighed to obtain its tare mass. A 3–5 g portion of the sample was then transferred to the tared crucible and dried at 105 °C for one hour. The crucible was again cooled in a desiccator and weighed immediately. Heating, cooling, and weighing were repeated until the mass of the crucible–sample system remained constant.

TBA value was quantified using method described in Polutu *et al*., (2015). A 10 g portion of the sample was weighed into a blender, combined with 50 mL of distilled water, and homogenised for 2 min. The resulting slurry was quantitatively transferred to a distillation flask, and the blender was rinsed with an additional 47.5 mL of distilled water. Hydrochloric acid (4 M) was then added (2.5 mL, or until the pH ≈ reached approximately 1.5), and the mixture was filtered through a vertical condenser. Heating was continued until 50 mL of distillate had been collected (≈ 10 min). The distillate was thoroughly mixed, and a 5 mL aliquot was transferred to a capped test tube, followed by 5 mL of thiobarbituric acid (TBA) reagent. The mixture was then vortexed to ensure homogeneity. The reaction mixture was heated in boiling water for 35 min and subsequently cooled under running tap water for 10 min. A reagent blank was prepared in parallel using 5 mL of distilled water in place of the sample. Absorbance was measured at 528 nm, using the blank as the zero reference. The TBA value was expressed as milligrams of malondialdehyde per kilogram of sample.

According to Wardah and Sihmawati (2022), sensory analysis is a scientific method used to assess and analyze the properties of a food ingredient or product based on sensory perceptions, including sight, smell, taste, and touch. Sensory testing was conducted to evaluate the organoleptic properties of flossed tilapia products, focusing on appearance,

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taste, aroma and texture. A modified hedonic test was used, scoring in accordance with the SNI 2346:2015 guidelines for fish and fish products. Fifteen semi-trained panellists were involved. The assessment used a three-level scoring scale of 9 (excellent/specific), 7 (fair/neutral) and 5 (poor/unspecific), with descriptions shown in Table 1.

***Data Analysis***

Chemical characteristic data are analyzed using analysis of variance (ANOVA) at a significance level (α) of 5%, and the sensory variables obtained are analyzed using the Friedman test at a level of 5%. If there is a significant difference, it will be continued with a multiple region test or Duncan's Multiple Test (DMRT) at a significance level (α) of 5%.

Table 1. Sensory Evaluation Criteria for Tilapia Floss

| Attribute | Score 9 (Good/Highly Specific) | Score 7 (Fair/Neutral) | Score 5 (Poor/Not Specific) |
|---|---|---|---|
| Appearance | Characteristic brown color, uniform fibers/powder, glossy | Characteristic brown color, less uniform fibers/powder, slightly dull | Non-characteristic brown color, non-uniform fibers/powder, dull |
| Taste | Very strong and distinctive product-specific taste | Fairly strong product-specific taste | Rancid, stale, or presence of off-flavors |
| Aroma | Clearly noticeable product-specific aroma | Neutral aroma, less distinctive | Slightly rancid or presence of foreign odors |
| Texture | Crispy and not clumping | Crispy but clumping | Not crispy and clumping |

## RESULT AND DISCUSSIONS

### A. Chemical Variables

Table 2 presents the results of the analysis of the effect of packaging type and storage time on the chemical variables of tilapia fish floss.

Table 1Results of water content and TBA value tests for tilapia fish floss

| Treatment | Water content (%) | TBA value (mg malonaldehyde/kg) |
|---|---|---|
| P1L1 | 7.5a | 0.1 |
| P1L2 | 10.65de | 0.14 |
| P1L3 | 11.12e | 0.18 |
| P1L4 | 12.79f | 0.2 |
| P2L1 | 7.14a | 0.1 |
| P2L2 | 8.25b | 0.16 |
| P2L3 | 9.02c | 0.17 |
| P2L4 | 10.18d | 0.19 |

Description: P1L1= kraft paper & stored for 0 day; P1L2= kraft paper & stored for 25 days; P1L3= kraft paper & stored for 50 days; P1L4= kraft paper & stored for 75 days; P2L1= PP Plastic & stored for 0 day; P2L2= PP Plastic & stored for 25 days; P2L3= PP Plastic & stored for 50 days; P2L4= PP Plastic & stored for 75 days; Numbers followed by the same letter indicate no significant difference based on the Least Significant Difference Test at $p = 0.05$.

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**Water Content**

The results of the analysis of variance (ANOVA) showed that the interaction of the type of packaging treatment and storage time had a significant effect on the water content of tilapia fish floss (P<0.05). The average water content of tilapia fish floss ranged from 7.14% -12.79%. The highest average percentage of water content of tilapia fish floss was still below the quality requirements of floss according to SNI, which is a maximum of 15%, so it can be said that fish floss stored for 75 days still meets the quality requirements of floss and is still suitable for consumption according to SNI 7690.1:2019. The water content in the storage time treatment increased from 0 days to 75 days of storage. The water content increased because the floss absorbed water vapor in the room around the storage. If the room around the storage has high humidity, the product's water content increases. Floss is a product produced from a hygroscopic drying process and easily absorbs moisture from the surrounding air. This opinion is supported by the statement of Leksono & Syahrul (2001) in Habibah *et al*. (2023), which states that storage conditions and packaging materials used are factors that can cause an increase in water content. This study was conducted at room temperature storage with an average air humidity of 86%. According to Esminingtyas (2006) and Sakti *et al*. (2016), air humidity can reach 86% at room temperature, so the product's water content can increase.

An increase in moisture content during storage is widely recognised as a marker of food deterioration, as cited in Hermawan (2023). Elevated water levels compromise product stability because high-moisture environments foster microbial proliferation and accelerate spoilage. Afdillah et al. (2018) corroborated this relationship, showing a continual rise in microbial counts in fish floss as storage time lengthened. The concomitant increase in moisture not only drives bacterial growth but also heightens the risk of yeast, mould, and filamentous fungi colonisation, which are organisms that flourish in substrates with high water activity.

The study's results showed that using PP plastic packaging had a lower water content for tilapia fish floss than kraft paper packaging during storage. According to Hadi (2018), the process of water vapor and oxygen entry is influenced by the density of the structure in both types of packaging, namely through the pores of the packaging material. The water content of tilapia fish floss packaged with kraft paper packaging is higher than that of tilapia fish floss packaged with PP plastic packaging. This is because the pore size of paper packaging is larger than that of plastic packaging. Plastic packaging has selective characteristics in its permeability to water vapor and $O_2$ compared to paper packaging (Nurminah, 2002 in Johnrencius *et al*., 2017). The permeability of PP plastic packaging is relatively low, namely 0.185 $g/m^2$.day.mmhg compared to the permeability of paper packaging, namely 4.0422 $g/m^2$.day.mmhg. Water vapor permeability determines the protective power of a package; the lower the permeability of the package, the higher the packaging's ability to suppress the rate of entry and exit of water vapor so that an increase in the product's water content can.

**TBA Value**

The results of the analysis of variance (ANOVA) showed that the interaction of packaging type and storage time did not significantly affect the TBA value of tilapia fish floss (P>0.05). The average TBA value of tilapia fish floss ranged from 0.1-0.2 mg malonaldehyde/kg. According to SNI 01-2352-1991 concerning the testing of TBA values of fishery products, it is stated that good fishery products have a TBA value of less than 3 mg

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malonaldehyde/kg sample. The average TBA value of tilapia fish floss at 75 days of storage was still below the maximum limit, so the floss at 75 days of storage still met the quality requirements and did not experience rancidity. The TBA value at the storage time treatment increased from 0 days to 75 days of storage, although not significantly. The increase in water content occurred due to the fat oxidation reaction in the floss. Several factors that affect the rate of fat oxidation are the presence of oxygen, temperature, and light. The more oxygen in the environment around the product, the faster the product will oxidize (Christie *et al*., 2015). The fat oxidation also dashes if the storage temperature is high enough. Using packaging on floss during storage helps reduce the oxidation reaction in floss. The use of packaging serves as a barrier against environmental oxygen exposure during storage, thereby minimizing oxidative reactions that can occur in shredded meat products. The storage process is carried out at a relatively low and stable room temperature, and the product is placed in a location protected from direct sunlight exposure, to maintain the stability of its physical and chemical properties during its shelf life.

The TBA value of flossed tilapia fish increased during storage. This is in accordance with research conducted by Saragih et al. (2019), shredded tuna experienced an increase in TBA value during storage, when on day 0 of storage the TBA value of floss was 0.33 mg malonaldehyde/kg and on day 28 of storage the TBA value of floss rose to 0.56 mg malonaldehyde/kg. The same thing was also found in the research of Salampessy et al. (2014), shredded dumbo catfish on day 0 TBA value of 0.004 mg malonaldehyde/kg and on day 10 storage rose to 1.136 mg malonaldehyde/kg. Malonaldehyde is produced by the decomposition reaction of hydroperoxides. The hydroperoxide decomposition reaction occurs due to the fat oxidation process during storage. The fat oxidation reaction causes the breakdown of fat into peroxides and then into aldehydes which are the result of the breakdown of hydroperoxides into malonaldehydes (Tungady et al., 2019).

The use of PP plastic packaging results in a lower TBA value of tilapia floss than the use of kraft paper packaging during the storage process. PP plastic has a denser molecular structure compared to kraft paper packaging. Therefore, PP plastic packaging has better oxygen resistance than kraft paper packaging. Each package's density and permeability also influence the packaging's oxygen resistance. In this case, PP plastic packaging has a lower permeability when compared to kraft paper. Packaging with low permeability indicates that the packaging has a dense structure to prevent interaction between the product and oxygen. Packaging with high density also indicates that the packaging has a dense structure and is not easily penetrated by fluids and gases. According to Sumoprastowo (2004) and Fransiska *et al*. (2022), kraft paper has a lower density and a high softening point than PP plastic.

## B. Sensory Variables

Wardhani (2023) determined that evaluation of sensory variables of food products is a crucial stage, considering its role in revealing consumer perceptions and preferences. Furthermore, information on shelf life provides a scientific foundation to ensure food quality and safety prior to consumption. In this study, sensory testing includes tilapia fish floss's appearance, aroma, flavor, and texture. Table 3 presents the test results on the treatment of packaging type (P) and storage time (L) of tilapia fish floss.

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Table 3. Results of sensory quality test analysis on tilapia fish floss

| Treatment | Appearance | Aroma | Flavor | Texture |
|---|---|---|---|---|
| P1L1 | 8.73c | 8.73b | 8.87 | 8.73c |
| P1L2 | 8.6bc | 7.8a | 8.6 | 8.20bc |
| P1L3 | 8.33bc | 8.07ab | 8.6 | 7.53ab |
| P1L4 | 8.33bc | 7.4a | 8.2 | 7.00a |
| P2L1 | 8.73c | 8.73b | 8.87 | 8.73c |
| P2L2 | 8.47bc | 8.07ab | 8.73 | 8.33bc |
| P2L3 | 7.93ab | 7.8a | 8.33 | 7.67ab |
| P2L4 | 7.53a | 7.53a | 8.07 | 7.13a |

Description: P1L1= kraft paper & stored for 0 day; P1L2= kraft paper & stored for 25 days; P1L3= kraft paper & stored for 50 days; P1L4= kraft paper & stored for 75 days; P2L1= PP Plastic & stored for 0 day; P2L2= PP Plastic & stored for 25 days; P2L3= PP Plastic & stored for 50 days; P2L4= PP Plastic & stored for 75 days; Numbers followed by the same letter indicate no significant difference based on the Least Significant Difference Test at p = 0.05.

## Appearance

Characteristics of the product's general appearance include color, size, shape, surface texture, purity level and carbonation of the product (Meligart *et al*., *2006). The results of the Friedman* test showed that the combination of packaging type and storage time (PL) treatment significantly affected the appearance of tilapia fish floss. The average score of the panelists assessment of the appearance of tilapia fish floss with kraft paper packaging ranged from 8.73 to 8.33 with the criteria of product-specific brown color, homogeneous powder/fibre, and bright. In contrast, PP plastic packaging ranged from 8.73 to 7.53 with the criteria of product-specific brown color, homogeneous powder/fibre, bright to product-specific brown color, less homogeneous powder/fibre, and rather dull.

The longer the storage, the lower the appearance of tilapia fish floss. Tridiyani (2012) and Saragih *et al*. (2019) stated that the longer the storage and the higher the storage temperature, the color of the fish floss will become increasingly brown due to the increased oxidation rate. According to Saragih *et al*. (2019), this browning reaction is called a non-enzymatic browning reaction, which results from the decomposition reaction of fat with proteins, peptides and free amino acids. The change in brown color causes the color of the tilapia floss to no longer be as specific brown as floss. The increase in water content in tilapia floss during storage also affects the appearance of fish floss. The increasing water content causes the fish meat to decompose quickly so that the appearance of the meat fibres becomes incomplete and dull. According to SNI (2019), the sensory quality for floss products has a minimum value of 7. In this study, the average appearance value given by the lowest panelists was still above 7, so the sensory quality for the appearance of floss is still above the SNI standard.

## Aroma

The results of the Friedman test showed that the combination of packaging type and storage time (PL) significantly affected the aroma of tilapia fish floss. The average panelist assessment score for the aroma of tilapia fish floss with kraft paper packaging ranged from

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8.73 to 7.4. In contrast, PP plastic packaging ranged from 8.7 to 7.5 with very strong product-specific criteria to strong product-specific criteria. There was no significant difference in floss packaged with PP plastic and kraft paper during 75 days of storage. The longer the storage, the lower the specific aroma of tilapia fish floss. The panelist assessment decreased because tilapia fish floss underwent an oxidation reaction caused by a lipid peroxide reaction during storage (Prasetyo *et al* ., 2018). The fat oxidation reaction will cause the fat to break down into volatile aldehydes and ketones and cause a rancid odor in tilapia fish floss. It can be correlated with the analysis of the TBA value in tilapia fish floss, which shows that different storage times and types of packaging affect the resulting TBA value. The highest TBA value produced in floss is still below the SNI standard limit; this is by the floss aroma test, where the rancid aroma in floss has not appeared. According to SNI (2019), the sensory quality for floss products has a minimum value of 7. The average odor score given by the lowest panelists is still above 7, so the sensory quality of floss's odor is still above the SNI standard.

### Flavor

The Friedman test showed that the combination of packaging type and storage time (PL) treatment did not significantly affect the flavor of tilapia fish floss. The average panelist assessment score for the taste of tilapia fish floss with kraft paper packaging ranged from 8.87 to 8.2. In contrast, PP plastic packaging ranged from 8.87 to 8.07 with specific product criteria. There was no significant difference in floss packaged with PP plastic and kraft paper during 75 days of storage. The longer the storage, the more the taste of tilapia fish floss decreased, although the decrease was insignificant. The decrease in taste was caused by the loss of organic acid components in the floss due to the long storage period. The decrease in taste in floss can be seen from the appearance of a rancid taste in the floss. Based on this study, there was no rancid taste in the floss; this is based on the study of the TBA value produced; the TBA value of floss was still below the maximum limit according to SNI. Manteu *et al.* (2024) stated that changes in taste can also be caused by biochemical breakdown and decomposition of proteins and fats. The increased water content in floss can also cause changes in taste; floss will become bland, and the taste will no longer be specific to floss. According to SNI (2019), the sensory quality for floss products has a minimum value of 7. The average value of the taste score given by the lowest panelists is still above 7, so the sensory quality for floss taste is still above the SNI standard.

### Texture

Texture is one of the sensory attributes assessed through the perception of touch or pressure, either by the oral cavity when biting, chewing, and swallowing, or through contact with the fingers, which reflects the physical response to food products (Faridah et al., 2021). The Friedman test showed that the combination of packaging type and storage time (PL) significantly affected the texture of tilapia fish floss. The average panelist assessment score for the texture of tilapia fish floss with kraft paper packaging ranged from 8.73 to 7. In contrast, PP plastic packaging ranged from 8.73 to 7.1 with the criteria of crispy, not clumping, to crispy, clumping. There was no significant difference in floss packaged with PP plastic and kraft paper during 75 days of storage. The longer the storage, the more the texture of the tilapia fish floss decreases. The decrease in the texture of tilapia fish floss is related to the water content contained in the floss during storage. The results of this decrease in texture align with the analysis of the water content of tilapia fish floss, which showed an increase in the water content during storage. The increase in water content in tilapia fish floss causes the floss to clump and not be crispy. In addition, the decrease in texture is also caused by the activity of microorganisms that degrade proteins into simpler compounds and decrease the protein's ability to bind water. The decrease in the water binding capacity of protein causes the texture to become soft (Nur, 2009 in Prasetyo *et al*., 2018). According to SNI (2019), the sensory quality for sh floss has a minimum value of 7. The average taste score the lowest panelists give is 7, so the sensory quality for abon texture is still above the SNI standard.

## CONCLUSION

The water content and TBA value of tilapia floss increased during storage. The use of PP plastic packaging resulted in lower water content and TBA values than the use of kraft paper. The highest water content and TBA values of tilapia shredded fish were on the 75th day; the values were still lower than the maximum SNI limit. The sensory value of tilapia floss (appearance, aroma, taste, and texture) decreased during 75 days of storage. PP plastic packaging and kraft paper did not show significant differences. All sensory parameters were still above the minimum SNI (2019) limit of 7.

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