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The Effect of Packaging Type and Temperature on the Characteristics of Habang Seasonings During Storage

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ABSTRACT

The red traditional South Kalimantan cooking spice indicates that the seasoning has a deep red appearance. Although the habang cooking seasoning has a dark red appearance with the main ingredient red chili, this spice does not have a spicy taste but tends to taste sweet. This study aimed to determine the effect of different packaging and storage temperatures on the spice's characteristics. This study used RBD method with 2 factors and 2 replications. Factor A is packaging variation and B is storage temperature. These observations included chemical tests, total microorganism tests, and sensory tests. Chemical tests and microorganisms were analyzed by the ANOVA and followed by the DMRT. Sensory test data were analyzed by the Kruskal Wallis and followed by the Post Hoc Test. Determination of the best results used the ranking method weighting. The results showed the characteristics were changed during storage. water content, peroxide number, and total microorganisms were increased in line with fat content and pH decreased. Sensitively, Habang cooking spices decreased in aroma, color, and viscosity during storage. The best Habang cooking seasoning was found in the use of cold temperature aluminum foil packaging on the 4th day of storage with a total parameter value of 8,224 and a total value of 30,195, chemical characteristics in the form of the water content of 31.46±0.02, a fat content of 69.67±0, 81, the pH value is 4.26±0.02, and the peroxide value is 3.15±0.06.

Keywords: Habang Seasoning, Type of Packaging, Storage Temperature

1. Introduction

There are many ready-to-use seasonings in the form of pastes, so anyone who wants to process food can do it easily and quickly. Hambali et al (2008) stated that seasoning in the form of paste is a seasoning that is still fresh, while seasoning in powder form is a dry seasoning. The spice of habang cuisine is a specialty of South Kalimantan. It is found in a variety of dishes such as fish, chicken, meat, and eggs. Habang means red in Banjar, which means that habang spice has a bright red appearance. The main component of this spice is dried red pepper. Although it uses chili peppers, it has no pungent taste and has a sweet taste due to the addition of brown sugar. Paste-shaped habang cooking spices are high in water and oil, which makes them prone to microbial growth and can affect product quality. Ketaren (2008) stated that seasonings in the form of paste are easily damaged by physical, chemical, and microbiological. Foods containing fats and oils are easily damaged by oxidation, heat, and microbiological growth during long-term storage. Because of that, the seasoning is no longer suitable for consumption.

Packaging plays an important role in protecting, slowing down, and limiting the growth of harmful microorganisms in the product from the environment to extend the product's shelf life. This study used aluminum foil (Alufo) and polyethylene (PE) packages and room and cold temperatures. Aluminum foil has excellent airtightness, flexibility, opacity, tastelessness, odorless, non-toxic, gas permeability, and conductivity, so it can be used for packaging greasy light-sensitive materials such as margarine and yogurt (Julianti & Nurminah, 2007). Polyethylene (PE) packaging, on the other hand, is plastic packaging that is used daily. Syarief et al., (1989) stated that polyethylene packaging has flexible properties. It is resistant to bases, acids, alcohols, detergents, other chemicals, water, and steam. It also has high tear strength and is easy to heat. The accuracy of the storage temperature selection is also one of the factors that can affect the life of the product. Besides the packaging, Herawati (2008) stated that product quality depends on storage conditions such as temperature. So far, the influence of the type of packaging and storage temperature is not known on the characteristics of habang cooking seasoning products during storage. This study aims to know the effect of packaging during storage on the quality of habang cooking seasoning.

2. Materials and Methods

Materials

The ingredients used in this study were dried red pepper, charlotte, garlic, ginger, cinnamon, cooking oil, salt, sugar, brown sugar, and water. The chemicals used were distilled water, hexane solvent, buffer, plate count agar (PCA), 85% NaCl, acetic acid, chloroform, potassium iodide, Na2S2O3, starch, and 70% alcohol.

The tools used in this study were blenders, aluminum foil, polyethylene plastic packaging, frying pans, spatula, analytical balances, splicer presses, ovens, dryers, grease bottles, filter papers, Soxhlet, Erlenmeyer, glass measuring cups, beakers, test tubes, funnel, Petri dish, spatula, aluminum foil, pH meter, autoclave, pipette, cotton swab, vortex, bunsen, eyelet needle, incubator, and frosted glass.

Methods

Design used

The design used in this study was a two-element factorial randomized block (RBD) design. The first element (A) was the type of packaging, which was aluminum foil and polyethylene plastic variations, and the second element (B) was the storage temperature, that was, room temperature and low temperature. In this study, 28 experimental units were obtained using two replicas.

Preparation Method

First was washing 14,08% of the dried red pepper, 12,32% shallot, 8,80%, garlic, 1,21% ginger, and 0,22% cinnamon (w/w). After that, the dried red pepper was cooked for ±15 minutes until tender, and the onions and garlic were roasted for 2 minutes. Then was ground shallot, garlic, ginger, and 600g of oil-softened dried red pepper in a blender for ±12 minutes. Next is putting the mixed ingredients in a frying pan and frying, then add cinnamon, 7,23% of, sugar, 6,03% of brown sugar, and 1,93% of salt (w/w). The cooking process runs at ±120°C for ±20 minutes. The temperature was measured after the spices were cooked, and the cooking temperature was ±12°C. When the seasoning was finished, proceed to pack.

Packaging Method

The packaging is rectangular with a size of 12×15 cm and the thickness of each package is 0.8 mm. Packaging of Habang cooking spices is done by putting the spices into each package of as much as 60 grams and then the packaging will be closed by gluing it on the top of each package using an adhesive press machine (impulse sealer) for 5 seconds on aluminum foil packaging and 4 seconds on the packaging PE plastic packaging.

Storage method

Habang cooking spices were stored at room temperature (26°C -28°C) and low temperatures (9°C-11°C). Packaged Habang cooking spices were stored at the time of observation, that is, on days 0, 4, 8, and 12.

Observation Method

Observations made in this study included moisture content (Horwitz, 2005), fat content with the soxhlet method (Horwitz, 2005), pH measurement (SNI 06-6989.11-2004), peroxide number with iodometry titration method, total microorganism test with Total Plante Count (TPC) method, sensory tests with scoring and hedonic method (SNI 01-2346-2006).

The organoleptic test was quoted from SNI 01-2346-2006. The test used the scoring and hedonic (favorability) methods including flavor, color, and the level of viscosity. Table 1 and Table 2. Showed the level of sensory scoring test and level of hedonic scoring test.

Table 1. level of sensory scoring test

Scoring Level	1	2	3	4	5
Flavor	Very Weak	Weak	Moderate	Strong	Very Strong
Color	Orange	Red-orange	Brownish red	Red	Dark Red
Viscosity	Not thick	Not thick enough	Quite thick	Thick	Very thick

Table 2. level of Hedonic scoring test

Scoring Level	1	2	3	4	5
Flavor; Color; Viscosity	Dislike very much	Dislike	Somewhat like	Like	Like Very much

Data analysis

The result of water content, fat content, pH, and peroxide were analyzed on day 12th by analysis of variance (ANOVA) with a Duncan Multiple Range (DMRT) follow-up test at a 5% significance level. The scoring and hedonic tests were evaluated using the Kruskal-Walls test, followed by testing from multiple comparisons at a 5% significance level. The best product was determined using the weighing ranking method (Malczewski, 1999)

3. Results and Discussion

The results of ANOVA showed that the interaction between the packaging factor and temperature did not have a significant effect, but a single packaging factor and temperature had a significant effect on the water content. The water content increased with storage time (Figure 1). According to Mustafidah and Widjanarko (2015), the increase in water content during storage is due to the uptake of water vapor from the environment to reach equilibrium.

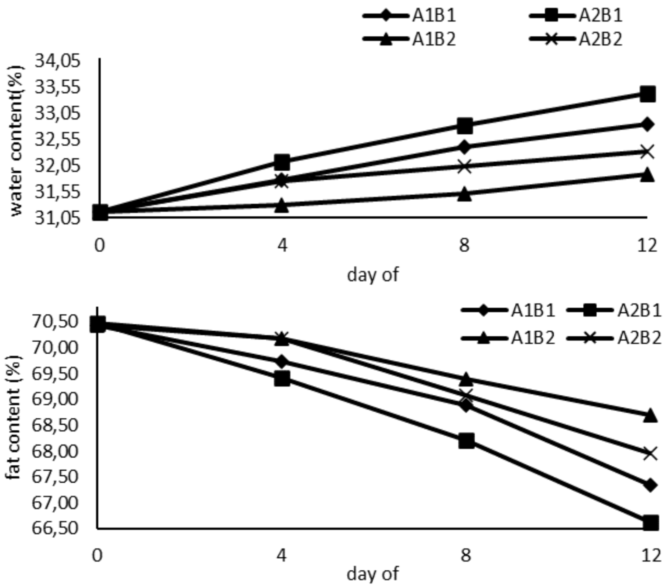
The results show that the seasoning water content in aluminum foil was lower than in the PE plastic packages. This is because the aluminum foil packaging is more impermeable to water vapor and oxygen, and the lack of packaging holes makes it difficult for water and oxygen to diffuse into habang seasoning (Permatasari et al, 2004). Solihin and Sutrisna (2015) stated that water vapor content can change due to water vapor uptake from the air into the product.

The water content of habang seasoning increased highly at room temperature stored but increased slowly at a cold temperature. In the storage of hot spices at room temperature, Hasfita and Husin (2013) stated that dry storage conditions and storage temperatures tend to be warm causing the speed of chemical reactions in the ingredients to run faster. In addition, habang cooking spices also have hygroscopic properties at room temperature. It can increase the water content at room temperature more than at cold temperatures.

Fat Content

The results of ANOVA showed that the interaction between the packaging factor and temperature factor, and the two individual factors, did not significantly affect the fat content of habang seasoning.

During storage, the fat content of habang seasoning was reduced (Figure 1). This decrease was due to the hydrolysis of fat during storage. The fat hydrolysis reaction was affected by the increased water content of habang seasoning. Maria (2017) stated that water content is generally inside-out proportional to fat content. According to Mamuaja (2017), a hydrolysis reaction occurs when fats and oils contain a certain amount of water. Exposure to air, light, room temperature, and moisture content of the material involved the deterioration of fat content. Therefore, the storage of habang seasoning at room temperature was significantly reduced compared to low temperatures (Triyanto et al., 2013).



Description:
A1B1 (Room temperature aluminum foil packaging);
A2B1 (Room temperature PE plastic packaging);
A1B2 (Cold temperature aluminum foil packaging);
A2B2 (Cold temperature PE plastic packaging);
Figure 1. The moisture and the fat content of habang seasoning during storage.

According to Fardiaz (2001), microbial activity also affects the reduction of fat content. Microorganisms need fat as an energy resource. Based on the temperature, they are more easily metabolized at room than at low temperatures. Proper packaging can reduce the hydrolysis of fats and the occurrence of contamination by environmental microorganisms. For habang seasoning packaging, aluminum foil packaging can reduce this occurrence more than PE plastic packaging.

pH (Acidity Level)

The results of ANOVA showed that the interaction between packaging and temperature did not have a significant effect, but a single factor of temperature and packaging had a significant effect on the pH of habang seasoning.

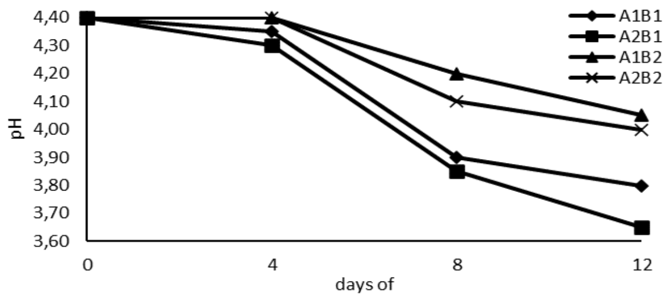
During the habang seasoning storage, the spices' pH dropped (Figure 2). According to Mamuaja (2017), the fat hydrolysis reaction is a reaction that releases the free fatty acid contained in the structure of fat molecules. The high-fat hydrolysis reaction also produces a lot of free fatty acid, which acidifies the pH of habang seasoning.

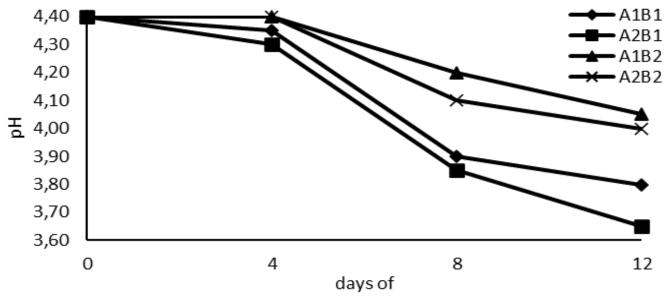
Aluminum foil packaging is more effective in maintaining the pH, this is because aluminum foil packaging has good water vapor permeability to reduce the occurrence of hydrolysis reactions that can cause changes in pH. In addition, the decrease in the pH can be caused by the activity of microorganisms. Rizkyyani et al., (2020) stated that the growth of microorganisms is usually followed by enzymatic reactions

Nutrients in the product become nutrients for lactic acid bacteria, which break down proteins, carbohydrates, fats, and other organic substances in the product into organic acids and lower the pH (Mirdalisa et al., 2016). When stored at room temperature, microbial activity is more likely to occur at room temperature, so the pH was more likely to change than when stored at low temperatures

Peroxide values

The results of ANOVA showed that the interaction of packaging and temperature had a significant effect and that single-factor packaging and temperature had a significant effect on the peroxide value of high-temperature habang seasoning.





Description:
A1B1 (Room temperature aluminum foil packaging);
A2B1 (Room temperature PE plastic packaging);
A1B2 (Cold temperature aluminum foil packaging);
A2B2 (Cold temperature PE plastic packaging
Figure 2. pH and Peroxide number of habang seasoning during storage

The peroxide value increased with the storage period (Figure 2). The increase in peroxide value occurred at room temperature and under refrigerated conditions, but the most significant increase occurred when it was stored at room temperature. The increase in peroxide level is associated with a decrease in fat content. The decrease in fat content is caused by the hydrolysis reaction of fat that produces free fatty acid compounds. The presence of free fatty acid is an early indicator of fat damage, as free fatty acid is more easily oxidized than other esters. The free fatty acid produced from the hydrolysis reaction accelerates fat oxidation by reducing surface tension and thereby increasing the rate of oxygen diffusion into fat Santoso (2018). Suroso (2013) found that increased peroxide level in spices is caused by the oxidative reaction of oxygen with various unsaturated fatty acids.

Under storage conditions at room temperature, oil reacts more easily with oxygen via the autoxidation mechanism of free radicals, thereby increasing the peroxide value of products characterized by rancidity.(Mamuaja, 2017). Raharjo (2006) stated that during production, the rate of fat oxidation reaction increases with increasing temperature and can decrease with decreasing temperature and heating time. In addition to raising the peroxide value, with the help of oxygen, other unwanted things can happen, such as microbial growth, vitamin denaturation, pigment damage, enzymatic browning process, and reduced flavor of packaged foods. Since the reaction rate also depends on the amount of oxygen available, the package plays an important role in avoiding or preventing the occurrence of these undesired situations (Piergiovanni and Limbo, 2010).

Total Microorganisms

The presence of microorganisms caused biological damage to spices. The excessive number of microorganisms in habang seasoning products can cause toxicity in consumers. The Total Plate Count (TPC) at room temperature for 72 hours is 1x104 colonies/gram based on BPOM RI Regulation No. 13 of 2019 for ready-to-use pasta. The average value of total microorganisms can be seen in Table 3.

The number of microorganisms increases during the storage period. It is shown in Table 3. Habang seasoning was already contaminated with microorganisms on day 0, but it was still low. According to Rahayu et al. (2000), pasta seasoning has a small number of microorganisms at the start of storage, and it is about 5 to 26 colonies per gram by pre-cooking the seasoning. On days 4-12 of habang seasoning products, observations showed increased microbial contamination in all packages.

Table 3. The average value of the total microorganisms of habang during storage

Packaging Type Variations	Storage Temperature	Total Microbes (CFU/g)			
		0	4	8	12
Aluminum Foil	Room temperature	2,5×102	2,9×105	2,55×106	7,05×106
	Cold temperature	2,5×102	3,4×104	2,51×105	1,46×106
PE Plastic	Room temperature	2,5×102	2,05×106	5,25×106	9,35×106
	Cold temperature	2,5×102	2,4×105	1,92×106	2,75×106

PE plastic packaging at room temperature showed the most increasing microbial contamination during storage. This indicates that the conditions in aluminium foil packaging can reduce microbial growth rate compared to PE plastic packaging. In addition, at room temperature during storage, microbial growth is faster. According to Waluyo (2005), the temperature limit for microbial life ranges from 0° to 90°C. Based on the temperature in which the microbes live, microbes can be divided into 3 groups, namely psychrophilic microbes (microbes that grow at 0°-30°C), mesophilic microbes (microbes that grow at 30°-60°C), and thermophilic microbes (microbes that grow at a temperature of 40°-80°C).

The pH affects the types of microorganisms that grow during storage. Waluyo (2005) found that microorganisms can generally grow at pH 3-6. Microbes are divided into three groups based on the pH at which they live: acidophilic, medium-affinity, and alkaline microorganisms. Sudiarto (2009) also found that the factors that influence the increase in microbial growth in foods are caused by the characteristics of the food and the environmental conditions. Food properties include water activity, pH, nutritional content, and antibacterial compounds. Environmental conditions include temperature, oxygen, and humidity. Microorganisms that can contaminate pasta seasonings include mucilage formation by lactic acid bacteria, acid formation by bacteria, and discoloration due to mold growth; it is associated with signs of food spoilage and the formation of ammonia and H2S changes the scent by various bacteria (Siagian, 2002). Starovicova and Hartemink (2017) stated that the microbiological damage caused by cooking spices is primarily caused by molds of the genera Penicillium and Aspergillus.

Scoring Test and Hedonic Flavour

The results of statistical evaluations using the Kruskal-Wallis test at the 5% level showed that the interaction between packaging and storage temperature did not significantly affect the flavor. In the two packages' flavor scoring, the values were slightly reduced. Table 4. shows the average value of the flavor scoring test.

Table 4. The average value Flavor Evaluation Scoring Test

Packaging Type Variations	Storage Temperature	Flavor
Aluminum Foil	Room temperature	4,18±0,11
	Cold temperature	4,26±0,04
PE Plastic	Room temperature	4,16±0,10
	Cold temperature	4,16±0,08

The results of the hedonic flavor test using the Kruskal-Wallis test at the 5% level showed that the interaction between packaging and storage temperature significantly affected the hedonic flavor. Table 7 shows the results of the hedonic post-test on the aroma. When combined with a flavor rating, the result was small and diminished but the rating remains at 4 (strong flavor). The flavor score was still graded 4, but from a pleasure point of view, there was a sharp drop in the range of 4.50 to 2.23 (like-dislike). This is because the first scent (sweet scent) turned into an unpleasant scent. The ingredients used to make these spices contained volatile compounds, so further evaporation reduces the flavor of the spices.

The decrease in the sensory flavor was associated with an increase in the number of peroxides and an increase in total microorganisms during storage. According to the spice recipe, which has an oil content of about 70%, this causes an oxidative reaction characterized by an increase in peroxide value, which can result in a change in flavor. An increase in the number of microorganisms can also lead to undesired flavor development. Ho et al., (2004) found that microbial spoilage damage leads to mucus formation, color flavor changes, and product stinks. In addition, the loss of sensual flavor can also be caused by pollution from environments such as temperature, oxygen, and humidity that occur continuously during storage. Fats or oils are damaged as their shelf life increases, especially due to the onset of rancidification due to the aerial oxidation of fats (Ketaren, 2008). Scoring Test and *Hedonic Color*

The results of the statistical analysis scoring using the Kruskal-Wallis test with a level of 5% showed that the interaction between packaging and temperature had no significant effect on the color. The average value of the color-scoring test can be seen in Table 5.

Table 5. The average value of the color-scoring test

Packaging Type Variations	Storage Temperature	Color
Aluminum Foil	Room temperature	4,30±0,02
	Cold temperature	4,34±0,04
PE Plastic	Room temperature	4,24±0,04
	Cold temperature	4,30±0,02

The results of the hedonic test for the color based on the results of the Kruskal-Wallis statistical test showed that the interaction factor of the packaging with temperature had no significant effect during storage. The average hedonic value color during storage can be seen in Table 7. Based on ratings and hedonic test tables, seasoning lost color during storage. Similar to the spice color hedonic test, the drop in color scoring was very small. Participants' favorite color was found in cold aluminum foil and PE plastic packaging (colors preferred).

Scoring Test and Hedonic Viscosity

The results of scoring statistical analysis using the Kruskal-Wallis test at the 5% level showed that the interaction between packaging and temperature had a significant effect on the viscosity of habang cooking spices during storage. Table 6. shows the results of a post-test to evaluate the viscosity during storage.

Table 6. Results of post-tests to assess the viscosity scoring test

Packaging Type Variations	Storage Temperature	Viscosity
Aluminium Foil	Room temperature	3,84±0,03a
	Cold temperature	3,99±0,06c
PE Plastic	Room temperature	3,81±0,04ab
	Cold temperature	3,95±0,02bc

The viscosity assessment showed that the habang seasoning initially had a thick viscosity, but by day 12 the viscosity had changed to a considerably thicker one. The largest change in the viscosity occurred in the room temperature PE plastic package, while the habang seasoning with the least change in viscosity was found in the two cold packages. The consistency is influenced by the recipe using ± 70% fat content and ± 30% water content. Oxidation reactions can change a product's taste, flavor, color, viscosity, and nutritional value, which is a major problem for fatty foods (Muhammad et al., 2019).

Table 7. The average hedonic value of Flavor, Color, and Viscosity

Packaging Type Variations	Storage Temperature	Flavor	Color	Viscosity
Aluminium Foil	Room temperature	3,62±0,13b	3,96±0,03	4,21±0,02
	Cold temperature	4,30±0,04c	4,01±0,00	4,28±0,02
PE Plastic	Room temperature	3,37±0,03a	4,01±0,02	4,19±0,03
	Cold temperature	4,11±0,10c	4,05±0,00	4,21±0,08

Note 1. Dislike very much, 2. Dislike, 3. Somewhat like, 4. Like, 5. Very much like

The results of the hedonic test for the viscosity based on the results of the Kruskal-Wallis statistical test using a 5% level showed that the interaction between the packaging used and the storage temperature during observation had no significant effect on the viscosity of the habang seasoning. The evaluation scores of the hedonic texture were preferably reduced but the reduction was very low and always rated out 4 of 5 scales. The average hedonic value of the habang seasoning viscosity during storage can be seen in Table 7

Best Product Determination

The best product is based on observations of all parameters including all microorganisms (very important parameters), hedonics (important parameters), and scores (less important parameters). For hedonics and scores parameters, the order of weights begins with scent, viscosity, and color. The best habang seasoning during storage is the A1B2 treatment with aluminum foil packaging at a low temperature of 4 days. The result was obtained, a storage date with a total parameter value of 8,224, and a total value is 30,195.

4. Conclusions

Habang seasoning, which is stored in different packages at different storage temperatures, affects habang spices' properties. This effect is indicated by an increase in water content, peroxide value, total microbial count, and also a decrease in fat content and pH. In addition, habang cooking spices lost flavor, color, and viscosity during storage.

The best habang seasonings based on weighted ranking analysis were found when using cold temperature with aluminum foil packaging on the 4th day of storage. The total parameter value is 8,224, the total value is 30,195, and it has chemical properties in the form of water content. 31,46% ± 0.02, fat content 69,67% ± 0.81, pH 4,26 ± 0,02, peroxide value 3.15 meq O2/100g ± 0.06.

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