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RESEARCH ARTICLE

EFFECT OF LOW TEMPERATURE STORAGE FOR UNCOOKED SALA LAUAK.

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Abstract

Sala lauak is known as a traditional snack from Pariaman, West Sumatera made from rice, dried fish and spices. It is sold in different ways which are ready-to-eat snack, uncooked sala and sala lauak flour. Nowadays, consumers prefer uncooked sala since they can cook at home and can be consumed fresher and healthier. However, the shelf life of uncooked sala is very short which limit product distribution and selling area. Based on survey of sellers, quality of uncooked sala only maintain for 12 hours. Further, there is still inadequate study on uncooked sala lauak and its change during storage. This study is observing quality change on uncooked sala that stored in the refrigerator condition (10°C) at room temperature (26-30°C). Uncooked sala was sealed in PP plastic for 6 days of studies. The quality component is related to the proximate components, hardness, color (°Hue and Chroma), and total plate count (TPC). Initially, uncooked sala has 68.01 % of water content, 1.38% of ash, 1.91% of protein, 0.047% fat, 28.67% of carbohydrate (by difference), hardness 168.5 gram force, and 79.12°Hue, 29.55 Chroma. Based on total plate count, too numerous to count (TNTC) were found on uncooked sala stored after 3 days while those at room temperature was already TNTC after the first day. It was observed that ash, protein content, fat, and hardness significantly different between uncooked sala stored in room temperature and to those in refrigerator while water content and color changing almost similar between those storage conditions.

Introduction:-

Sala lauak is classified as a traditional snack and served as side dishes for breakfast or eat it solely. It is made from rice flour, dried fish, and spices such as turmeric powder, turmeric leaves, red chili, and salt (Kamsina and Anova, 2011; Yulastri, 2009). Previously, sala lauak used remained rice from yesterday instead of rice flour. Since it is basically from rice, sala lauak is an alternative healthy snack without gluten content, suitable for people with the gluten allergy and autistic patients. Nowadays, sala lauak becomes a typical food of Pariaman and souvenirs after visiting this area (Febriana, Rachmawanti, and Anam, 2014; Marliyanti, Hastuti, Sinaga, 2013). Home industries that produce sala lauak are growing along with culinary and tourism development in Pariaman area.

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Today, *sala lauak* is sold in different ways. Consumer can buy *sala* as a ready-to-eat snack on street vendors or people buy *sala lauak* flour. *Sala lauak* flour is made from rice that soaked for one night and spices that mixed together and processed into flour then roasted. However, making fresh *sala lauak* from scratches or *sala lauak* flour is not simple. To make *sala lauak* from *sala lauak flour,* it still needs additional ingredients such as dried fish and spices as explained by Kamsina and Anova (2011). This condition gives an idea for home industries to produce and sell uncooked *sala* which is rounded *sala* dough. This dough only needs to be fried before serving. Uncooked *sala* is preferable to consumers since it can be cooked at home, served directly after frying and healthier than those fried *sala lauak* in the market.

Unfortunately, uncooked *sala* has a short shelf life. The packaging of uncooked *sala* uses only mica plastic for 20-30 rounded *sala* dough. Based on a survey of sellers in by Handayani et al. (2017), quality of uncooked *sala* only maintain for 12 hours. Since uncooked *sala* has a short shelf life, the producer cannot answer many demands particularly during Ramadhan and Eid Fitri Celebration. Around this two months, people from other cities in Indonesia back to *kampung* to have a family celebration and eat traditional food such as *sala lauak*. In addition, they want to bring back *sala lauak* as snack or souvenir at the end of the holiday. The producers of uncooked *sala* rejected demands from other cities in Indonesia that required 3-4 days to be delivered. Demands actually come from West Sumatera people live in other cities but they want to eat this traditional dish. The condition of market demand for uncooked *sala* is an opportunity for home industries to expand their productivity. Thus, development in process production and technology utilization are needed in optimizing added values from this local product.

Previous research mainly related to variation and addition ingredients of *sala lauak*. Kamsina and Anova (2011) observed the quality of different flour and fish processing for *sala lauak* while Febriana et al. (2014) used different kind of rice flour to make *sala lauak.* Next, Sari et al. (2013) explored different varieties of fish and rice flour for *sala lauak* as a snack for autistic patient. For applying technology for uncooked *sala,* there is still inadequate study on *sala lauak* particularly uncooked *sala* and its change during storage. It is important to understand the quality change during storage such as appearance, nutrition content, and food safety in order to apply technology for product development.

Low-temperature storage was used to maintain quality of fruit, vegetables and food products. Low temperature storage such as refrigerator is a basic and affordable white goods appliance in a household (Mcneil & Letschert, 2010). Refrigerator storage was utilized by Kung et al. (2017) for control hazardous level of histamine on milk-fish sticks and to prolong the shelf-life of tempeh bacem (boiled tempeh with spices) (Rochim, 2014), and surimi from mixed fish by Jannah (2012) & Harahap (2012). Thus, storing uncooked *sala* at low temperature might prolong its shelf life. This study was observed on quality changes during low temperature storage compared to those in room temperature.

Materials and Methods:-

Uncooked *sala* was obtained from local market in Padang area, Indonesia at the same day with production day. Samples were packed in PP plastic and sealed using hand sealer. Then, samples were put in room temperature at 26-30ºC and refrigerator at 10ºC.

The moisture and ash were conducted using weight difference method. Fiber content was determined from the loss in weight of the crucible and its content on ignition. Carbohydrate was analyzed by summing of the percentage of moisture, ash, crude protein either extracts and crude fibers were substracted from 100. The nitrogen value as protein precursor from a substance was analyzed by micro Kjeldahl method involving sample digestions, distillation and titration. All the proximate values were reported in percentage using AOAC method.

For Total Plate Count (TPC), five grams of sample of uncooked *sala* for each treatment was serially diluted four times to obtain a $1:10^4$ dilution, spreaded on plate and incubated for 24 hours. Next for hardness, texture analyzer was utilized with cylinder probe and speed at 1.5 mm/s. Color meter (Hunter Lab Color flex) was used to observe L, a, and b value of sample then Hue and Chroma can be calculated.

Statistical analyses were conducted using SPSS 16.0 for Windows (SPSS Inc., Chicago USA). In this study, significant effects of storage condition ($p<0.005$) were observed based on Duncan's range tests.

Results and Discussion:-

There is a possibility of chemical changes to occur during storage leads to food deterioration including reducing quality of nutritional quality (Rahman, 2007). Thus, chemical changes were analyzed based on proximate analysis in 6 days of observation. From proximate analysis, water content was observed for both room and refrigerator as shown in Table 1.

Table 1:-Water Content and Ash of Uncooked *Sala* in Room and Refrigerator Storage for 6 Days

Time (d)	Water Content (%)		Ash (%)	
	Room	Refrigerator	Room	Refrigerator
0	68.01±0.36	68.01±0.36	1.38±0.01	1.38±0.01
1	70.45±0.28	69.25±0.48	1.31±0.008	1.21±0.07
2	69.20±0.24	68.92±0.01	1.46±0.03	1.43±0.008
3	69.21±0.08	69.39±0.03	1.44±0.003	1.46±0.003
4	70.64±0.16	70.45±0.46	1.23±0.09	1.21±0.08
5	74.27±2.89	69.13±0.05	1.84±0.01	1.86±0.03
6	68.80±0.25	68.36±0.28	1.64±0.001	1.66±0.003

Mansor et al. (2012) noted that water content in food product with oily content affect shelf life of products since it is related to rancidity and oxidation process. As the result, water contents for uncooked *sala* in room temperature are between 68.01 % and 74.27 % which was significant difference per day during observation. Further, a significant difference on level $p = 0.005$ was also noted from water content of uncooked *sala* in refrigerator. The values were between 68.01 % and 70.45% which were lower than those kept in room temperature. However, there is no significant change on water content between uncooked *sala* in room and uncooked *sala* in refrigerator as shown in Table 1. Further, it can be inferred from this analysis that uncooked *sala* has a relative high even it is kept on refrigerator. A proper packaging and store are required since high water content is related to vulnerability food products.

Uncooked *sala* in both storage conditions were observed in 6 days for ash component. Ash is remained inorganic components in food products (Nielsen, 2010). Ash from uncooked *sala* is related to inorganic compound such as from dried fish, rice and spices. Ash of uncooked *sala* in room temperature was about 1.23% to 1.84% while those in refrigerator was about 1.21-1.86% of ash. Initially, ash was about 1.38% and change with no significant value at $p=0.05$ per day of storage period in both storage conditions. However, there was a significant difference on ash content between uncooked *sala* kept in room and those in refrigerator on which ash content of uncooked *sala* from room temperature was higher than those from refrigerator.

Next, protein analysis was conducted using the Kjeldahl method. Nielsen (2010) noted that nitrogen is the major distinctive factor of protein. Protein analysis using this method is basically counting all organic nitrogen from material. Initially, protein content of uncooked *sala* was about 1.91% as shown in Table 2. Protein content of uncooked *sala* kept in room temperature was significantly difference with those in refrigerator. Although there was no significant change in protein content per observationday, protein reached the highest value on the 3rd day observation which were 1.87% in room temperature and 2.03% in refrigerator. It might related to microorganism activities that still high and counted as protein too. At the end of observation, protein of uncooked *sala* were 1.44% in room temperature and 1.65% in refrigerator.

Fat component of uncooked *sala* was also analyzed during 6 days observation. Fat in food products as explained by Nielsen (2010) is included phospholipids and triacyl glycerols which named oils at room temperature or fat if it is solid in room temperature. At the first day of observation, uncooked *sala* has 0.05% of fat content. Similar to protein content, there was insignificant increase on 3rd day observation for fat before decreasing. However, uncooked *sala* in room temperature and refrigerator has significant difference. Uncooked *sala* in room temperature has between 0.05% to 6.2% while those in refrigerator has between 0.05% to 5.73% as shown in Table 3.

Qualitative and quantitative analysis for carbohydrates is to determine food product composition and also product characteristics (Nielsen, 2010). Carbohydrate by difference was calculated for uncooked *sala* in 6 days observation as shown in Table 4. There was 28.66% of carbohydrate (by difference) in uncooked *sala* initially. No significant difference on carbohydrate of uncooked *sala* during observation days but the different was significant at $p = 0.05$ for

carbohydrate of uncooked *sala* in room temperature to those in refrigerator. Carbohydrate of uncooked *sala* from refrigerator was higher than those from room temperature might indicate that microorganism use more carbohydrates for its growth in room temperature.

Table 2:-Protein of Uncooked *Sala* in Room and Refrigerator Storage for 6 Days

Time (d)	Protein (%)	
	Room	Refrigerator
0	1.91±0.01	1.91±0.01
1	1.52±0.05	1.33±0.01
2	1.70±0.11	1.46±0.03
3	1.87±0.03	2.03±0.05
4	1.41±0.03	1.59±0.01
5	1.76±0.16	1.62±0.10
6	1.44±0.03	1.65±0.22

Table 3:-Fat of Uncooked *Sala* in Room and Refrigerator Storage for 6 Days

Time (d)	Fat(%)	
	Room	Refrigerator
0	0.05±0.00	0.05±0.00
1	0.23±0.00	0.17±0.01
2	6.20±0.03	5.60±0.05
3	5.13±0.01	6.39±0.00
4	5.40±0.00	5.73±0.05
5	5.45±0.04	5.76±0.06
6	5.49±0.02	5.61±0.05

Table 4:-Carbohydrate (*by difference*) of Uncooked *Sala* in Room and Refrigerator Storage for 6 Days

Time (d)	Carbohydrate (*by difference*) (%)	
	Room	Refrigerator
0	28.66±0.33	28.66±0.33
1	26.49±0.33	28.04±0.53
2	27.22±0.16	27.96±0.00
3	27.20±0.09	26.44±0.18
4	26.46±0.05	26.53±0.56
5	21.84±2.70	27.09±0.21
6	27.85±0.29	28.00±0.10

Beside proximate analysis, color changing was analyzed since it is easily change people perspective in purchasing product. Based on °Hue and Chroma number, color of uncooked *sala* is classified as yellow-red as stated in Hutching (1999). The yellow color of uncooked *sala* comes from turmeric as explained by Febriana et al. (2014) and Kamsina & Anova (2011) which is one of spices added to *sala lauak*. Before 6 days observation, uncooked *sala* has 79.12°Hue and 29.55 of Chroma number. However, there was non-significant difference on color changing along storage period and between room and refrigerator condition at p level 0.05. The °Hue and Chroma number of uncooked *sala* were between 77.06 °Hue to 89.50 °Hue and 25.87 to 32.29 of Chroma number as shown in Table 5.

Table 5:-Hue and Chroma of Uncooked *Sala* in Room and Refrigerator Storage for 6 Days

	Room		Refrigerator	
	Hue	Chroma	Hue	Chroma
0	79.12	29.55	79.12	29.55
1	81.04	29.76	80.95	29.08
2	80.95	25.87	77.07	30.56
3	81.29	31.08	87.42	24.21
4	83.50	31.33	86.68	29.84
5	79.03	32.30	89.50	24.28

6	89.05	30.11	82.41	29.35

Samples in this study were packaged in polypropylene (PP) plastic then be sealed. PP, as noted by Brennan (2006), is a product of low-pressure polymerisation of propylene using catalyst. PP has a low permeability to water vapour and gases. PP is usually coated with PE or PVC to make it heat-sealable and to improve its properties. Physical changes and defect such as mucus can be observed from packaging using PP.

Defect on food product happened as the result of environment, oxygen, humidity, temperature change followed by changing on texture, color, and mucus on product surface because of microbiological (Habibah & Aminah, 2004). Total Plate Count (TPC) was conducted to obtain information about general microbiological activity in uncooked *sala* during storage in room temperature and the refrigerator. The result of TPC is defined as colony forming units (CFU) to estimate the present number of cells as colony. In counting colonies, there are named general ranges as common acceptance for countable numbers of colonies on a plate which are 30-300. The upper limit per plate which is 300 is related to competition of colonies for space and nutrients (Sutton, 2011). At the initial day of storing, it was found that uncooked *sala lauak* was already containing 7.2×10^5 cfu. Next, too numerous too count was detected on the first day for sample from room temperature storage. For samples that kept in refrigerator, TNTC was found after the third day of storage. Further, the mucus was found from both storage condition samples along with reducing value of samples hardness on the first 3 days. It might be related to condition where too numerous to count (TNTC) of total plate count after 3 days in refrigerator and after the first day for those in room temperature.

During packaging, microorganism can spread as the results of poor packaging and storing. Using packaging with high permeability to gas and water vapour takes a risk since microorganism contine to grow and increase the number during storage (Forsythe & Hayes, 1998). Further, contents of food product are supporting bacteria and fungi to grow. Food with high protein content is easily become a suitable growth area for *Staphylococcus aureus* that was identified causing toxicity by producing enterotoxin. At the very worst, enterotoxin from *S. Aureus* is heat resistant although after heating at temperature 100°C for 30 minutes (Balia et al., 2013).

In addition, Marth (1998) noted in extended storage using refrigerator that psychrotrophic and mesophilic pathogens might still grow. There are many food products that already contaminated from initial production process such as raw material handling even during processing, storage and distribution. In this study, uncooked *sala lauak* had 7.2×10^5 cfu as the result of total plate count. Thus, the preventive control such as good manufacturing practices (GMPs), sanitation and hygiene have important contribution to the shelf life of uncooked *sala lauak*.

Table 6:-Total Plate Count Results of Uncooked *Sala* in Room and Refrigerator Storage for 6 Days

Storage time (d)	Room	Refrigerator
0	7.2×10^5	7.2×10^5
1	TNTC	7.0×10^4
2	TNTC	3.8×10^6
3	TNTC	TNTC
4	TNTC	TNTC
5	TNTC	TNTC
6	TNTC	TNTC

Next, we also conducted test for hardness of uncooked *sala* during storage in room and refrigerator. Initially, the hardness of uncooked *sala* was 170.25 gram force as shown in Figure 1. After the first 3 days of storage time, it was found that uncooked *sala* become harder particularly those in refrigerator. The hardness of uncooked *sala* from refrigerator after 3 days in storage was 260.25 gram force which was higher than those from room temperature (129.75 gram force). This unfavorable condition related to caking on amorphous component of rice flour as one of main components in *sala lauak*. As explained by Bhandari (2007), amorphous component is vulnerable temperature changing and humidity.

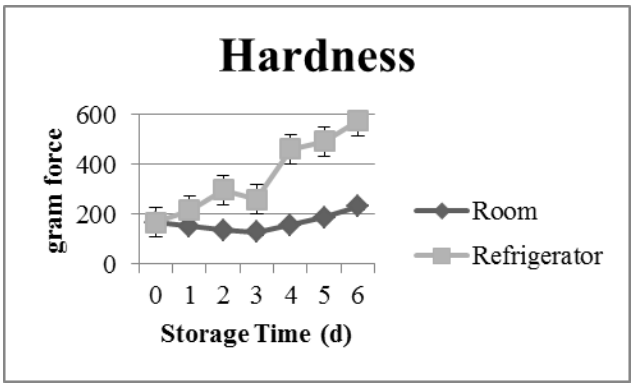

Figure 1:-Hardness of Uncooked *Sala* in Room and Refrigerator Storage for 6 Days

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