Effect of Packaging Type on the Physical and Sensorial Qualities Beef Fried Meatballs during Storage at Ambient Temperature

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ABSTRACT---- ***Beef fried meatballs (basreng) is an innovation from meatballs. Dry textured basreng is sensitive to air and prone to rancidity, so packaging is required to minimize and the effect of storage time at room temperature. Basreng samples were packaged in non-vacuum polyethylene, vacuum polyethylene, aluminum foil vacuum, and composite can. Each was tested at weeks 0, 2, 4, 6, and 8. Parameters were observed for physical quality (pH and hygroscopicity) and sensory (color, taste, aroma, texture, acceptability). Physical quality data were analyzed using a Complete Randomized Design with a 4x5 factorial pattern. Mean differences were tested with Duncan's New Multiple Range Test. Sensory quality data was analyzed with Friedman's non-parametric analysis. Each treatment was in triplicate. The highest pH value for composite can is 6.43. The best sensory score is the composite can. The results of statistical analysis showed that the packaging treatment had a significant effect (P<0.05). Storage time also had a significant effect (P<0.05) on the physical quality which decreasing the pH value to 6.08, increasing the hygrocoposity value to 0.19 and decreasing the sensory score. The conclusion of this study was that types of packaging and storage time affected the physical and sensory qualities than other treatments.***

Keywords--- Beef Fried Meatballs, Type of Packaging, Storage Time, Physical Quality, Sensory Quality

1. INTRODUCTION

Beef fried meatballs are an innovation of meatballs that have high nutritional value, have a savory taste and crunchy texture so that they are liked by many people. Beef fried meatball is a type of dry textured food that is very sensitive to air or easily sluggish and prone to rancidity during storage, so packaging is needed that can minimize damage that occurs during storage. Packaging greatly affects the shelf life of a food product. Beef fried meatball packaging usually only uses pouch packaging made of aluminum foil and PE (Polyethylene) type plastic. This packaging has high hermetic properties, so it is possible for oxygen to enter the packaging. Three types of packaging and packaging methods used in this study include vacuum polyethylene, vacuum aluminum foil, and composite can. The vacuum packaging method is a method of vacuuming air in a package that provides an airtight atmosphere, so that the oxygen and water content in the package will not be much. Therefore, the researcher wanted to know the influence of several types of primary packaging on the physical and sensory qualities of beef fried meatballs during storage at ambient temperature.

2. MATERIALS AND METHODS

Tool. The tools that will be used for making beef fried meatballs include digital scales, meat grinder, chopper, cutting tools, stainless steel knives, cutting boards, spoons, scoops, basins, trays, pans, stoves, and vacuum fryers. The tools that will be used for the physical quality test include analytical scales, pH meter, 50 ml beaker, 50 ml measuring cup, room temperature and humidity recorder. The tools that will be used for testing the sensory quality are questionnaire sheets and pens.

Material. The ingredients that will be used for making beef fried meatballs are beef, tapioca flour, eggs, salt, flavoring, garlic, pepper, scallions, lime leaves, celery leaves, water, and cooking oil. The ingredients that will be used for packaging are polyethylene packaging with a size of 25 x 40 cm with a thickness of 0.03 mm, aluminum foil packaging with a size of 25 x 40 cm with a thickness of 0.03 mm and a composite can with a size of 8.4 x 20 cm. The ingredients that will be used for the physical quality test are beef fried meatball samples, aquadest, and phosphate buffer solution pH 4 and 7. The ingredients that will be used for sensory quality testing are beef fried meatball samples.

Beef fried meatball Making Method. Beef is cut and finely ground using a meat grinder machine. All ingredients are weighed and mixed until homogeneous using a chopper for 5 minutes, during the mixing process, add 50 ml of ice

water to the dough. Then put the dough in a food grade plastic using a triangle plastic. Then put in boiling water at 80ºC and boiled for 20 minutes. The cooked meatballs are removed and drained. Beef fried meatball formulation can be seen in Table 1.

Beef fried meatball Making Method. The beef is cut and finely ground using a meat grinder machine. All ingredients are then weighed and mixed until homogeneous using a chopper for 5 minutes, during the mixing process, the dough is added with 50 ml of ice water. The dough is then put in a foodgrade plastic using a plastic triangle. The dough is then put in boiling water at 80ºC and boiled for 20 minutes. The cooked meatballs are removed and drained. Then put the meatballs in the refrigerator until frozen. Frozen meatballs are cut with a cutting tool with a thickness of ± 3 mm. Fried the meatball slices in a vacuum fryer at 80ºC for 20 minutes. The cooked beef fried meatball are removed and put in the spinner for 5 minutes. The cooked beef fried meatball are packaged in 4 packages and contain 250 grams of beef fried meatball, each treatment was in triplicate. The beef fried meatball are stored at room temperature and will be tested for physical and sensory quality at weeks 0, 2, 4, 6 and 8. Beef fried meatball formulation can be seen in Table 1.

Table 1. Beef Fried Meatballs Formulation

Ingridients	Weight (gram)	Percent (%)
Beef	125	13,08%
Tapioca flour	500	52,30%
Egg	100	10,46%
Salt	1	0,10%
Flavoring	16	1,67%
Garlic	70	7,32%
Pepeper	4	0,42%
Leek	20	2,09%
Lime leaves	10	1,05%
Celery leaves	10	1,05%
Water	100	9,56%
TOTAL	956	100%

Physical Quality

pH Values Testing. The pH value test was carried out according to Soeparno's (1994) instructions. The pH value was measured using a pH meter which was calibrated in a phosphate buffer solution of pH 4 and 7. The sample was weighed 2 grams and diluted with 18 ml of distilled water and then tested with a pH meter three times. The results obtained are averaged.

Hygroscopicity. The hygroscopicity value was carried out according to Rosiani's (2015) instructions. The hygroscopicity value was calculated based on the difference between the initial weight and the final weight when the sample was sluggish. Beef fried meatball crackers were left for 12 hours at a temperature of 28 to 37ºC and humidity ranged from 54 to 64%. Measurements of product weight, temperature and RH are carried out every 3 hours for 12 hours.

Sensory Quality

Sensory quality test refers to Triyannanto and Lee (2017). Sensory testing involved 11 semi-trained panelists aged 17 to 21 years, male and female. Panelists were given a questionnaire to fill out during the sensory test. Samples were labeled with a random number for each treatment. Panelists have to rinse their mouths after analyzing each different sample. Sensory quality parameters are color, aroma, taste, texture, and acceptability. Beef fried meatball samples with different packaging were presented and the panelists were asked to assess according to the preference value. Kartika et al. (1988) stated that the level of preference or hedonic scale consists of a scale of 1. Very dislike, 2. Dislike, 3. Somewhat like, 4. Like, and 5. Very like.

3. RESULTS AND DISCUSSIONS

pH Value

The results of statistical analysis showed that the difference in packaging treatment had a significant effect ($P<0.05$) on the pH value of beef fried meatball. The average pH values for non-vacuum polyethylene, vacuum polyethylene, vacuum aluminum foil, and composite can packaging were 6.36, 6.39, 6.39, and 6.43, respectively. The pH value of vacuum polyethylene packaging and vacuum aluminum foil packaging showed the same value. This is because vacuum packaging can suppress the decrease in product pH. Yulianti (2018) states that the vacuum technique in packaging is better able to suppress the decrease in product pH and also microbial growth with less oxygen available in the packaging. The removal of air in vacuum packaging can ensure anaerobic conditions.

The results of statistical analysis of the pH value of beef fried meatball showed that storage time had a significant effect on the pH of beef fried meatball stored at room temperature ($P<0.05$). The pH values of beef fried meatball at 0, 2,

4, 6, 8 weeks storage were 6.38, 6.63, 6.33, 6.53, and 6.08. The decrease in pH can be caused by chemical reactions and bacterial activity during storage. Chemical reactions that occur during storage produce lactic acid which is produced by lactic acid bacteria. The higher the lactic acid produced, the pH value of beef fried meatball will decrease. The lower the pH value, the greater the possibility of rancidity or rancidity. Ismed et al. (2017) stated that the longer the storage, the lower the pH value of processed meat products. This is caused by the activity of microorganisms that cause the process of glycolysis which produces lactic acid. The results of the Beef fried meatball pH test can be seen in Table 2.

Table 2. pH Value of Beef Fried Meatball on Different Packaging and Storage Time

Storage time (week)	Packaging				Average^{s}
	Control polyethylene non vacuum	Polyethylene vacuum	Alumunium foil vacuum	Composite can	
0	6.40 ± 0.10^{bp}	6.33 ± 0.12^{bp}	6.37 ± 0.12^{bcp}	6.43 ± 0.06^{bp}	6.38 ± 0.09^{c}
2	6.67 ± 0.06^{ap}	6.57 ± 0.12^{ap}	6.57 ± 0.12^{ap}	6.73 ± 0.06^{ap}	6.63 ± 0.11^{a}
4	6.33 ± 0.06^{bp}	6.33 ± 0.06^{bp}	6.27 ± 0.12^{cp}	6.40 ± 0.10^{bp}	6.33 ± 0.11^{c}
6	6.57 ± 0.06^{ap}	6.57 ± 0.06^{ap}	6.50 ± 0.00^{abpq}	6.50 ± 0.00^{bpqr}	6.53 ± 0.05^{b}
8	6.00 ± 0.00^{cr}	6.17 ± 0.06^{cp}	6.10 ± 0.00^{dp}	6.07 ± 0.06^{cp}	6.08 ± 0.07^{d}
Average^{s}	6.36 ± 0.24^{a,b}	6.39 ±0.18^{a,b}	6.39 ± 0.19^{b}	6.43 ± 0.23^{a}	

^{a,b,c} Different superscripts in the same row show significant differences (P<0.05)
^{p,q,r,s} Different superscripts in the same column show significant differences (P<0.05)
^{a,b,c,d} Different superscripts in the same row and column show significant differences (P<0.05)
^{s} Significant

Hygroscopicity Value

The hygroscopicity of beef fried meatballs is the ability of beef fried meatballs to absorb water. The results of statistical analysis showed that the difference in packaging treatment had no significant effect (P>0.05) on the hygroscopicity value of beef fried meatballs. The average value of hygroscopicity in all packages was 0.13, 0.14, 0.14 and 0.12. This can be affected by the temperature and humidity of the same room when the hygroscopicity test is carried out. The temperature and humidity of the environment are the same, so the ability of beef fried meatballs to absorb water is also slightly different. Rosiani et al., (2015) stated that the level of water absorption of crackers depends on environmental conditions. An environment that has a high RH causes the crackers to quickly absorb water from the environment which will cause the crackers to become sluggish.

The results of statistical analysis of the hygroscopicity of beef fried meatball showed that storage time had a significant effect on the hygroscopicity of beef fried meatball stored at room temperature (P<0.05). The average hygroscopicity value of beef fried meatball beef stored for weeks 0, 2, 4, 6, 8 were 0.10, 0.11, 0.11, 0.14, and 0.19. The increase in the value of hygroscopicity was due to the longer storage of beef fried meatballs. The longer storage causes the cavity on the surface of the beef fried meatballs to get bigger, so the ability to absorb water also increases. Susanti (2007) states that the expansion can occur because it is caused by the formation of air cavities which are influenced by the length of storage, the longer the storage, the more air cavities are formed, causing more bound water. The results of the hygroscopicity test of beef fried meatball on different packaging methods and storage times can be seen in Table 3.

Table 3. Hygroscopicity Value of Beef Fried Meatball on Different Packaging and Storage Time

Storage time (week)	Packaging				Average^{s}
	Control polyethylene non vacuum	Polyethylene vacuum	Alumunium foil vacuum	Composite can	
0	0.11 ± 0.06^{bp}	0.13 ± 0.04^{abp}	0.12 ± 0.05^{bp}	0.10 ± 0.01^{bp}	0.10 ± 0.04^{bc}
2	0.10 ± 0.52^{bp}	0.09 ± 0.03^{bp}	0.08 ± 0.03^{bp}	0.12 ± 0.04^{abp}	0.11 ± 0.04^{c}
4	0.09 ± 0.03^{bq}	0.09 ± 0.04^{bpq}	0.13 ± 0.01^{abp}	0.11 ± 0.02^{abpq}	0.11 ± 0.03^{c}
6	0.09 ± 0.01^{bq}	0.19 ± 0.05^{ap}	0.14 ± 0.03^{abpq}	0.13 ± 0.01^{apq}	0.14 ± 0.04^{b}
8	0.23 ± 0.04^{ap}	0.19 ± 0.06^{apq}	0.20 ± 0.05^{apq}	0.12 ± 0.02^{abq}	0.19 ± 0.05^{a}
Average^{ns}	0.13 ± 0.07^{a}	0.14 ± 0.06^{a}	0.14 ± 0.05^{a}	0.12 ± 0.02^{a}	

^{a,b,c} Different superscripts in the same row show significant differences (P<0.05)

[p,q,r,s] Different superscripts in the same column show significant differences (P<0.05)
[a,b,c,d] Different superscripts in the same row and column show significant differences (P<0.05)
[s] Significant
[ns] not significant

Sensory Testing

The results of the analysis showed that the difference in packaging had a significant effect (P<0.05) on the sensory quality of Beef fried meatball. The test results showed that the Beef fried meatball with Composite Can packaging had the highest score on all parameters. Composite can packaging is best in terms of overall acceptability. This is because the Composite Can packaging has low permeability and transmission of oxygen which causes fat oxidation and can reduce the sensory quality of Beef fried meatballs. The lower the permeability of the packaging, the more closed the packaging, the more difficult the transfer of gas molecules into the package and to the environment so that the oxidation process that causes changes in the sensory quality of the product can be prevented. Beef fried meatball sensory quality can also be affected by the water content of Beef fried meatball. The higher the water content of Beef fried meatball, the lower the sensory quality of Beef fried meatball, especially for texture parameters. Syarief (2007) states that packaging can cause quality changes such as aroma, color and texture which are influenced by the transfer of water vapor and oxygen. Oxygen can cause oxidation, especially in food products that contain fat. Oxygen permeability can occur through the packaging laminate. Adawiyah et al. (2016) stated that the decrease in preference for aroma can be caused by fat oxidation. The oxidation of fats present in the product by air can cause a rancid odor. Pradipta (2011) stated that the factor that can affect the texture of crackers is water content. The high water content will make the cracker texture softer. Moniharapon (2013) states that the use of appropriate packaging can maintain the acceptability or acceptability of food products including color, taste and damage.

The results of the analysis showed that storage time had a significant effect (P<0.05) on the sensory quality of Beef fried meatballs. The beef fried meatball sensory score from week 0 to week 8 decreased in all sensory parameters. The color change that occurs during storage is due to an oxidation reaction that causes a brownish color in beef fried meatballs. The decrease in aroma in a product can be caused by microbial activity that can produce a rancid odor in the product. The decrease in taste in a product can be caused by a decrease in pH during storage which causes a sour taste in the product. The decrease in texture is caused by an increase in water and air content that enters the packaging during storage which causes changes in texture. The decrease in acceptability of a product can be caused by rancidity caused by microbial activity during storage. Purwanto et al., (2016) stated that enzymatic browning is triggered by an oxidation reaction catalyzed by enzymatic phenoloxidase. This enzyme can catalyze the oxidation reaction of phenol compounds which causes a brown color change. Wijayanti et al., (2011) stated that rancidity in crackers can occur due to oxidation of oil/fat. This is influenced by the quality of the oil, the frying process and the packaging system used. Rosalina and Silvia (2015) stated that the texture of crackers can be influenced by the ability to absorb water during storage, the permeability of the packaging, and the relative humidity of the environment. Nur (2009) stated that the decrease in overall acceptability during storage was caused by the rotten, rancid and mucilage odor of the product. The results of the Beef fried meatball sensory test with different packaging and storage times can be seen in Table 4.

Table 4. Sensory Quality Score of Beef Fried Meatball on Different Packaging and Storage Time

Parameter	Storage time (week)	Packaging				Averages
		Control polyethylene non vacuum	Polyethylene vacuum	Alumunium foil vacuum	Composite can	
Color	0	2.50 ± 0.97	3.60 ± 0.52	3.30 ± 0.48	3.60 ± 0.52	3.25 ± 0.75^{b}
	2	3.20 ± 0.42	3.50 ±0.71	3.50 ± 0.53	3.10 ± 0.57	3.34 ± 0,57^{a}
	4	2.40 ± 0.52	3.30 ± 0.68	3.30 ± 0.68	3.50 ± 0.53	3.14 ± 0,70^{b}
	6	2.70 ± 0.48	2.90 ± 0.57	2.90 ± 0.57	3.00 ± 0.47	2.89 ± 0,49^{c}
	8	2.90 ± 0.74	2.90 ± 0.57	3.30 ± 0.68	3.40 ± 0.52	3.14 ± 0,63^{b}
	Averages	2.76 ± 0.67^{c}	3.25 ± 0.65^{b}	3.26 ± 0.58^{b}	3.33 ± 0.55^{a}	
Aroma	0	2.80 ± 1.03	2.90 ± 0.57	3.00 ± 0.67	3.10 ± 0.74	3.00 ± 0,75^{b}
	2	3.20 ± 0.42	3.00 ± 0.47	3.50 ± 0.53	3.50 ± 0.71	3.30 ± 0,55^{a}
	4	2.30 ± 0.48	2.80 ± 0.63	2.80 ± 0.42	3.50 ± 0.71	2.89 ± 0,69^{c}
	6	2.70 ± 0.48	2.70 ± 0.48	2.40 ± 0.70	2.90 ± 0.57	2.73±0,59^{c,d}
	8	2.30 ± 0.68	2.40 ± 0.70	2.70 ± 0.67	3.00 ± 0.67	2.64 ± 0,72^{d}
	Averages	2.69 ± 0.69^{c}	2.84 ± 0.63^{b,c}	2.91 ± 0.70^{b}	3.20 ±0.68^{a}	
Taste	0	2.91 ± 0.70	3.09 ± 0.54	3.00 ± 0.63	3.18 ± 0.41	3.05 ± 0,57^{b}
	2	3.09 ± 0.54	3.09 ± 0.54	3.36 ± 0.92	3.27 ± 0.47	3.20 ± 0,63^{a}
	4	2.64 ± 0.67	3.27 ± 0.47	3.45 ± 0.69	3.55 ± 0.52	3.23 ± 0,68^{a}
	6	2.91 ± 0.94	3.09 ± 0.70	2.91 ± 0.94	3.27 ± 0.65	3.05 ± 0,81^{b}
	8	3.09 ± 0.70	3.09 ± 0.70	3.27 ±0.47	3.45 ± 0.52	3.23 ± 0,61^{a}
	Averages	2.93^{c} ± 0.72	3.13^{b} ± 0.58	3.20^{ab} ± 0.71	3.35^{a} ± 0.52	
Texture	0	2.82 ± 1.12	3.00 ± 0.78	3.00 ± 0.78	3.00 ± 0.78	2.95 ± 0,86^{a}
	2	2.73 ± 0.79	3.18 ± 0.87	3.45 ± 1.13	2.91 ± 0.83	3.07 ± 0,93^{a}
	4	2.64 ± 0.67	2.91 ± 0.54	2.82 ± 0.60	3.18 ± 0.60	2.45 ± 0,73^{b}
	6	2.73 ± 0.47	2.91 ± 0.54	2.91 ± 0.70	3.09 ± 0.54	2.30 ± 0,90^{c}
	8	2.64 ± 0.51	2.55 ± 0.52	2.91 ± 0.54	3.00 ± 0.45	2.41±0,95^{bc}
	Averages	2.44 ± 0.92^{b}	2.64 ± 0.93^{ab}	2.73 ± 0.99^{a}	2.75 ± 0.84^{a}	
Acceptability	0	2.73 ± 0.79	2.91 ± 0.70	3.00 ± 0.78	3.00 ± 0.78	2.98 ± 0,73^{b}
	2	2.91 ± 0.30	3.09 ± 0.70	3.45 ± 0.82	3.45 ± 0.82	3.18 ± 0,66^{a}
	4	2.64 ± 0.67	2.91 ± 0.54	2.82 ± 0.60	3.18 ± 0.60	2.89±0,62^{bc}
	6	2.73 ± 0.47	2.91 ± 0.54	2.91 ± 0.70	3.09 ± 0.54	2.91 ± 0,56^{b}
	8	2.64 ± 0.51	2.55 ± 0.52	2.91 ± 0.54	3.00 ± 0.45	2.78 ± 0,52^{c}
	Averages	2.73 ± 0.56^{c}	2.87 ± 0.61^{bc}	3.02 ± 0.71^{b}	3.16 ± 0.57^{a}	

^{a,b,c,d} Different superscripts in the same row and column show significant differences (P<0.05)
^{s} Significant

4. CONCLUSION

Based on the results, it can be concluded that the composite can packaging is better in maintaining the quality of the physical and sensorial of beef fried meatball compared to the control packaging, polyethylene and vacuum aluminum foil. Long storage can reduce physical and sensory quality of beef fried meatball. Beef fried meatballs of all types of packaging are still suitable for consumption until 8 week.

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