

## **Investigation on physical change and storability of meatball after treated with different levels of liquid smoke and storage time**

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### **ABSTRACT**

This present work investigated physical change and storability of buffalo meatball after treated with different levels of liquid smoke and storage time. Completely randomized design consisting of 2 factors (liquid smoke levels: 0, 1, 2%; storage time: 0, 1, 2, 3 weeks) was arranged, with 3 replications. Analysis of variance was employed to evaluate data, followed with LSD test. The results showed that liquid smoke could reduce shear force of meatball and TPC, but increase rancidity. Meanwhile, all parameters studied (shear force, TPC, and rancidity) tended to be lower along with storage time. In addition, both factors seemed to exhibit similar response to shear force and TPC. In conclusion, the addition of liquid smoke 2% and storage time of 1 week resulted in the most desirable effect on buffalo meatball.

**Keyword:** buffalo meat, liquid smoke, meatball, storability

### **INTRODUCTION**

Meatball, named as *bakso* in Indonesia, is a popular food across the country. It is nutritious and highly susceptible to growth of microorganisms; thus, meatball shelf-life is short. It is possible to extend storability of meatball with aid of natural preservatives while considering health aspects. Liquid smoke made from coconut shell has been recognized as the best candidate—natural and eco-friendly—for preserving meatball. Setiadji (2000) found that liquid smoke was known capable of extending the shelf-life of foods.

The antimicrobial activity of liquid smoke related to content of acid compounds (acetic, propionate, butyrate, and valerate), carbonyl, and phenol. Presence of these acid compounds noticeably influenced flavor, pH, and food storability. Carbonyl compounds reacted with protein, and thus, resulting in color changes. Phenol could be major source of flavor and displayed bacteriostatic and antioxidant properties.

Zuraida (2008) found that fish meatball treated with liquid smoke 2% and cold-stored for 20 days was still acceptable to consume and had lower TPC compared to untreated meatball. Additionally, treatment of liquid smoke 7% in meatball stored at  $4\pm 1^\circ\text{C}$  could enhance shelf-life of the meatball up to 15 days and inhibit reduction of pH and water content.

Haras (2004) reported that smoke treatment of *cakalang* fish for 15 min using liquid smoke of coconut shell at level of 2% and stored at room temperature could retain quality of smoked fish up to 4 days. Meanwhile, other reports of Abustam and Likadja (2008), Kusumaningrum and Sutono (2008), Zuraida (2008) found that liquid smoke in meatball played essential roles in slowing spoilage, thus extending shelf-life of the meatball. Liquid smoke powder may be useful as source of antioxidant and antimicrobial, as well as binding agent, for improving quality of meatballs and avoiding from quality degradation during storage.

The aim of this study was to understand the effect of liquid smoke, storage time, and their interaction on quality of meatball properties. Therefore, the best level of liquid smoke and storage time could be achieved.

## METHODS

### Research Location

The experiment was conducted for about 4 months (August – December 2016) in Laboratory of Meat and Egg Processing Technology, Faculty of Animal Science, Hasanuddin University.

### Materials and Instruments

Meat samples (9 kg) were obtained from *Longissimus dorsi* section of 3-years male buffalo, supplied from Animal Slaughtering House of Tamangapa in Makassar, South Sulawesi, Indonesia. Other ingredients of the meatball included tapioca starch as filler, salt, ice, seasonings (pepper and garlic), and liquid smoke derived from coconut shell prepared from Laboratory of Engineering, Faculty of Agriculture Technology, Gadjah Mada University, Yogyakarta.

Chemicals used included TBA (Thiobarbituric Acid) (Merck 108180) reagent, HCl 4 M, glacial acetic acid (ReAgent), distilled water, buffer peptone water (BPW) (Merck 107228.0500) and Nutrient Agar (NA) (Oxoid CM0003). The main instrument for meatball manufacturing included food processor, stove, pan, bowl, and knife. Meanwhile, instruments for sample analysis included autoclave, CD shear force, glassware, sample plastic bag, waterbath, stomacher, incubator, micropipette, petri dish, Bunsen, and beaker glass.

### Sample Preparation

Fresh meat collected from slaughtering session of 02.30 am in RPH Tamangapa was kept in plastic bag, stored in coolbox, and immediately transported to laboratory. At 6 am, the meat was separated from fat. Subsequently, meatball was made according to following steps.

1. Meat Preparation

Connective tissue and fat in meat sample was removed. Then, post-rigor meat (*Musculus Longissimus dorsi*) was weighed for next formulation.

2. Grinding I

The meat was generally cut into small cubes prior to grinding, and then ground together with ice cubes and salt.

3. Grinding II  
After grinding I, the blending was then ground again with addition of tapioca starch, ice cubes, smoke flour, and seasonings based on prepared formulation.
4. Shaping  
The mixture of meat was then shaped into balls.
5. Boiling  
The shaped meatballs were then boiled in pan containing hot water (60 – 80 °C) till hardening and floating. Meatballs were drained and cooled.
6. Storage at 2 – 5°C  
Meatball samples were divided into three main groups according to concentration of liquid smoke flour named as K0, K1, and K2. Each group was chilled for a certain period of time as follows: 0 day (P1), 1 week (P2), 2 weeks (P3) and 3 weeks (P4) in refrigerator at 2 – 5°C.

### Parameters

Meatballs were evaluated for quality including Total Plate Count (TPC) value, rancidity (Shimadzu 70069) and shear force modification.

### *Experimental Design and Statistical Analysis*

Completely Randomized Design (CRD) of 3 × 4 factorial was arranged. Each experimental unit was performed at triplicates. Data were evaluated using analysis of variance, and significant difference among means was compared using Least Significant Difference (LSD) test (Gasperz, 1994).

## RESULTS

### Meatball Shear Force

Shear force of meatballs showed an important indicator closely related to level of tenderness. Higher tenderness of meatball was represented by a smaller requirement of force needed to cut it (Abustam, 1993). The meatball shear force was presented in Table 1.

Table 1. Shear force (kg/cm<sup>2</sup>) of meatball made from post-rigor buffalo meat treated with different levels of liquid smoke and storage durations

Level of liquid smoke (%)	Shear force(kg/cm <sup>2</sup> )				Average
	Period (Week)				
	0	1	2	3	
0	0.23±0.02	0.39±0.11	0.32±0.06	0.34±0.90	0.32±0.91
1	0.30±0.90	0.38±0.07	0.37±0.03	0.36±0.21	0.35±0.11
2	0.23±0.04	0.30±0.91	0.27±0.06	0.34±0.14	0.28±0.09
Average	0.25±0.06	0.35±0.09	0.32±0.06	0.35±0.13	

The results revealed that the addition of liquid smoke did not affect significantly shear force of the meatball. As expressed in Table 1, the increase in liquid smoke level tended to either raise or suppress the shear force, though not statistically differed. This clearly indicates that presence of

liquid smoke has no significant effect on this parameter, subsequently affecting level of meatball tenderness. Abustam *et al.* (2010) found that meatball tenderness could not also be affected by grinding and mixing, but also resultant of reaction induced by components from liquid smoke (phenol, carbonyl, acid) as antioxidants capable of retarding protein oxidation.

Different levels of storage statistically showed insignificant difference ( $P>0.05$ ) in meatball shear force. In short, there was a slight increase in shear force during first week of storage. The value was then decreased in the second week and increased again in the third week. This suggests that factors in this present study seem to be less effective in altering the studied parameter.

### Rancidity

TBA test was performed to evaluate level of fat oxidation in food matrix during storage, expressed as TBA value (Apriyantono *et al.*, 1989). When TBA value is high, it shows a higher level of rancidity, vice versa. Rancidity constitutes an essential indicator for degradation of fat and oil (Zuhra, 2006). The profile of meatball rancidity during storage was presented in Table 2.

Table 2. Rancidity (mg malonaldehyde/kg) of meatball made from post-rigor buffalo meat treated with different levels of liquid smoke and storage durations

Level of liquid smoke (%)	Rancidity (mg malonaldehyde/kg)				
	Period (Week)				Average
	0	1	2	3	
0	0.10±0.07	0.19±0.15	0.31±0.19	0.28±0.21	0.22±0.16
1	0.29±0.23	0.50±0.08	0.50±0.43	0.44±0.25	0.43±0.25
2	0.16±0.11	0.36±0.25	0.58±0.69	0.40±0.29	0.37±0.37
Average	0.18±0.16	0.35±0.20	0.46±0.43	0.37±0.23	

The incorporation of liquid smoke did not show significant effect on rancidity of the meatballs ( $P>0.05$ ). As shown in Table 2, there was a dual effect by presence of liquid smoke, either increasing or decreasing, but not statistically differed.

Similarly, level of meatball storage seemed to have no significant effect on rancidity ( $P>0.05$ ). At glance, we could see that the rancidity increased during first 2 weeks of storage, but then decreased at last week of storage. This instability of rancidity could be linked to the role of antioxidant agents, contributing to insignificant change in rancidity levels during storage. Ernawati *et al.* (2012) stated that treatment using liquid smoke enabled to suppress oxidation rate during storage.

### Total Plate Count

Total plate count (TPC) was conducted to determine total bacterial colonies in sample, indicating freshness of the product, mainly associated with high contribution of bacteria to food spoilage (Fardiaz, 1993). TPC value was presented in Table 3.

Table 3. TPC value (Log10) of meatball made from post-rigor buffalo meat treated with different levels of liquid smoke and storage durations

Level of Liquid Smoke (%)	TPC value (Log10)				
	Period (Week)				Average
	0	1	2	3	
0	3.89±0.52	5.28±0.14	5.96±0.68	7.23±0.04	5.59±1.31 <sup>A</sup>
1	3.02±0.43	4.70±0.61	5.55±0.58	6.53±0.58	4.95±1.43 <sup>B</sup>
2	3.58±0.53	4.20±0.12	5.48±0.60	6.11±0.35	4.84±1.10 <sup>B</sup>
Average	3.49±0.57 <sup>A</sup>	4.73±0.56 <sup>B</sup>	5.66±0.58 <sup>C</sup>	6.62±0.58 <sup>D</sup>	

Different superscripts in similar row and column indicated very significant difference ( $P < 0.01$ )

TPC value was highly affected by treatments of liquid smoke ( $P < 0.01$ ). The addition of liquid smoke 1% could decrease TPC value compared to control treatment, but it did not differ from addition of liquid smoke 2%. Pszczola (1995) stated that phenol was reported as the main antioxidant agent in liquid smoke. Antioxidative properties of phenol linked to high boiling point mainly for 2,6-dimethoxyphenol, 2,6 dimethoxyphenol-4-methylphenol and 2,6-dimethoxy-4-ethylphenol.

### DISCUSSION

The decreasing of TPC is closely related to the antioxidant and antimicrobial activities of phenol and acids present in liquid smoke. Soldera *et al.* (2008); Sunen *et al.* (2001) reported that antimicrobial agents in liquid smoke from coconut shell derived from phenols (and derivatives) and acids. In addition, Muratore and Licciardello (2005) found that liquid smoke could be natural antimicrobial agent for food use. Phenol compounds and their derivatives demonstrated either bacteriostatic or bactericidal effect, capable of deactivating essential enzymes, coagulating SH- and NH-group protein.

Besides liquid smoke, period of meatball storage also displayed significant difference ( $P < 0.01$ ) in TPC value. The value continuously increased till last week of storage, which was associated with growth of bacteria in samples. Some of bacteria especially from psychrophilic are capable of surviving in cold condition. Adam and Moss (2000) stated that number of bacteria would increase along with period of time due to presence of cold-resistant bacteria, primarily those from psychrophilic bacteria.

The existence of psychrophilic bacteria remarkable contributed to degradation of food quality. Soeparno (2005) stated that food should be chilled in short period of time, since the quality of food might be reduced with increase in storage time, affected by initial number of microorganisms which determine storability of fresh and processed meat.

### CONCLUSION

The addition of liquid smoke was found capable of reducing shear force, lowering TPC, and rising rancidity of the meatballs, but all these parameters were observed to increase along with storage time. The most desirable characteristic of meatballs was reached at addition of liquid smoke 2% and storage time of 1 week.

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