Original Research Article

The Quality of Spent Hen Chicken Sausage with Tomato Paste at Different Refrigerated Storage Time

ABSTRACT

Aims: This research aims to determine the quality of spent hen chicken sausage with the tomato paste at different refrigerated storage time based on pH, color, moisture content, total microorganism, and rancidity

Study design: This research are an laboratory experimental with a completely randomized design.

Place and Duration of Study: This research are located in Laboratory of Animal Product Technology, Faculty of Animal Science, University of Brawijaya.

Methodology: This research are using a 4 treatments and 5 replications. The main focus are a different storage time for spent hen chicken sausage on refrigerator (4˚C). The 4 treatments are 0 day (D_0), 7 days (D_1), 14 days (D_2), and 21 days (D_3)

Results: The different storage time on spent hen sausage with tomato paste gave a very significant effect ($P < .01$) on pH, color analysis (L a*b*), moisture content, total microorganism, and rancidity. pH, moisture content, total microorganism, and rancidity are increased during storage time meanwhile for color analysis are decreased during storage time.

Conclusion: Except for being a natural food colorant, tomato can be used for natural antioxidant. The addition of tomato paste on spent hen sausage can extend spent hen sausage's shelf life until 21 days on refrigerated temperature (4˚C). The further research are needed for consumer safety on spent hen chicken sausage with the addition of tomato paste.

Keywords: spent hen meat, sausage, tomato paste, restructured meat, storage time

1. INTRODUCTION

Indonesia is a large country with the population of 278,26 million people. Food are always been an issued for public. The most popular protein food in Indonesia is an egg and chicken meat. Beaf are not so popular because it's more expensive than chicken meat. The chicken meat consumption in Indonesia are only 0,158 kg/capita and most of them are from broiler meat [1]. Spent hen chicken are a chicken that already have a low egg productivity because of their old age. Spent hen chicken potentially can be used to increase the consumption of chicken in Indonesia because spent hen chicken has a high nutrition such as 59.8% moisture content, 18.5% of protein, 14.9% of fat, and 5.3% of mineral [2]. Public didn't like to consume spent hen meat because it has an excessive texture and easier to get rancid. The solution that

can improve the quality of spent hen chicken so the public will accept it are using a restructured meat technology.

Restructured meat technology are a technology that can improve the quality of a meat. The example of restructured meat are chicken sausage. Sausage are a food that all ages of people like to consume but sometimes they ask for a safety statement. In market place, sausage tend to have a nitiic as antioxidant so it has a longer shelf life but the excessive use of nitric can cause an illness such as cancer [3] The demand of safety food from public are rising so the used of synthetic antioxidant needs to be reduced. A natural antioxidant can be used as a synthetic substitute. Moreover it's easier to get and more healthy.Tomato are the example of natural antioxidant.

Tomato (*Solanum lycopersicum*) are a holticulture product that can be used for a food colorant and antioxidant. Tomato has a carotenoid, phenolic compounds, vitamins C, and E so it can potentially used as natural antioxidant in food products such as sausage [4]. The use of tomato already known in public. Qiu and Chin [5] states that the use of tomato powder can expand sausage shelf time because it has some natural antioxidant that can destroy some free radicals. The simillar report are Choi [6] states that tomato are a rich antioxidant components that can extend shelf life of meat, tomato can be used as antimicroba and reduce a meat pathogen such as *C. pefringens*. This study aims to know the quality of spent hen sausage with the addition of tomato paste at different refrigerated storage time.

2. MATERIAL AND METHODS

2.1 Materials

The material used on this research are spent hen sausage with the addition of 15% tomato paste. The ingredients for making spent hen sausage are spent hen meat (60g), tomato paste (15g), garlic (3g), tapioca (6g), canola oil (10g), skim milk powder (5g), ice cube (10g), and seasoning ingredients such as salt (2g), sugar (2g), pepper (0.5g), ginger powder (0.25g), nutmeg powder (0.25g), and mushroom powder (1g). For analysis are distiled water, buffer 4 and 7, peptone, PCA (*Plate Count Agar*), acetic acid, chloroform, potassium iodide, and sodium thiosulphate.

2.2 Methods

This research using a laboratory experimental with CRD (Completely Randomize Design) 4 treatments and 5 replications. The 4 treatments are a different storage time which 0 day (D0), 7 days (D1), 14 days (D2), and 21 days (D3). The storage temperature was 4˚C (refrigerated).

2.3 Data Analysis

The collected data are tabulated using Microsoft Excel 2013 and further analysis using ANOVA methods. Duncan Multiple Range Test (DMRT) are use when there's a significant or very significant effect on data.

2.4 Spent Hen Sausage Production

Dice the spent hen meat that already removed from skin, fat, and bone. Put the diced meat into meat grinder, and grind the meat with addition of salt and ice cube. Add the other ingredients like garlic, tapioca, canola oil, skim milk powder, sugar, pepper, ginger powder, nutmeg powder, and mushroom powder. Also add the 15 g of tomato paste. Grind again until homogen and fine. Put the sausage batter into selulose casing using a sausage stuffer. Boiled the sausage for 20 minutes in 80˚C water. Put the boiled sausage into cold water for 10 minutes. Store the cooked spent hen sausage on 4˚C refrigerator. Spent hen sausage are ready for further analyzed.

2.4 Quality of Spent Hen Sausage

2.4.1 pH Value

pH was determined using a pH meter. 5 g sample was crush with mortar and pestle then put it on pot film. Diluted the sample with 10 g distiled water. Before using a pH meter, pH meter must calibrated using a standard buffer solution (buffer pH 7 and 4). Put the pH meter electrode into buffer solution 7 then 4. After it steady, put the pH meter electrode into diluted sample, wait for 5 minutes. pH values can be seen on screen.

2.4.2 Color Analysis

Color was determined using a color reader. Before analysing sample with color reader, color reader must calibrated using black and white plate. Cut the sample about 2 cm x 2 cm x 2 cm and then place it on a tray. Place color reader lense on top of the sample and click the power button. Color values can be seen on screen with 3 types of color which are redness, yellowness, and lightness.

2.4.3 Moisture Content

Moisture content was determined using gravimetric method. Weighed the petri dish without sample (A). Weighed 2 g of sausage sample, put on the petri dish that has been on the 105°C oven for 12 hours and weighed it (B). Dry the sample for 12 hours, then placed it on desiccator for 10 minutes before weighed it (C). The final weight can be calculated using the moisture content formulation =

$$moisture\ content\ (\%) = \frac{(B-C)}{(B-A)} x\ 100\%$$

2.4.4 Total Microorganism

Total microorganism was determined using total plate count (TPC) methods. Calculation for total microorganism using a pour plate method with the range of colonies 25 – 250.

2.4.5 Rancidity

Total rancidity was determined using peroxide value. Prepare 10 gram of sample then put it on Erlenmeyer, add 30 mL of acetic acid and chloroform (3 : 2). Add 0,5 mL of potassium iodide and add 30 mL of distiled water. Titrate the sample using sodium thiosulphate and peroxide value can be calculated using formulation =

$$Peroxdie\ value\ \left(\frac{meq}{kg}\right) = \frac{titration\ volume\ x\ normality\ of\ sodium\ thiosulphate}{sample\ weight} x\ 100$$

3. RESULTS AND DISCUSSION

3.1 pH Value

pH values of different storage time spent hen sausage with the addition of tomato paste are presented in Table 1. Very significant effect are shown in pH ($P < .01$). pH values increased during storage time until 21 days. The lowest pH are on 0 days storage time with 6.40 and the highest are on 21 days storage time with 6.64. An increase of pH are related to an increase of total microorganism. The longer storage time, microorganism tend to grow so the pH increased. This is because metabolites of microorganism on meat and caused a protein deamination [7]. The higher pH value also can increase fat oxidation that can cause a rancidity [8].

Sangkeun et al. [9] report that the addition of sappan extract on pork sausage as natural antioxidant can increase pH with increased storage time. The increase of pH value are mainly because of microorganism. Similar research were report by Talukder et al. [10] that the addition of black plum extract on chicken patties increase significantly ($P = .05$) when being store for 3 days. Metabolites of microorganism can be a reason for pH value to increase.

3.2 Color Analysis

Color analysis (L a*b*) of different storage time spent hen sausage with the addition of tomato paste are presented in Table 1. Very significant effect are shown in Lightness (L), Redness (a*), and Yellowness (b*) ($P < .01$). Lightness, redness, and yellowness decreeased during storage time until 21 days. Tomato paste can gave a reddish color on spent hen sausage because tomato contain a natural food colorant namely lycopene and b-carotene. Lycopene and b-carotene are sensitive into oxygen, light, and heat [11]. Storage time can decrease lightness (L), redness (a*), and yellowness (b*) mainly because of fat oxidation. Unsaturated fatty acid can caused a oxidation when it reacted to oxygen. When unsaturated fatty acid react to oxygen, it made a new compounds known as hidroperoxide that can caused an off odor and off color [12].

Qiu and Chin [5] report that the addition of tomato powder on beef patties can decrease the color when it stored for 14 days. Red pigment on tomato, lycopene, are decreased because of oxidation. Another study were report by Hwang et al. [13] that the color of frankfurter with addition of beetroot extract as natural food colorant and antioxidant decrease from 15.48 to 14.83. Betalains pigment on beetroot also sensitive to oxygen so it's possible to decrease when fat oxidation occurs.

3.3 Moisture Content

Moisture content of different storage time spent hen sausage with the addition of tomato paste are presented in Table 1. Very significant effect are shown in moisture content ($P < .01$). Moisture content increased during storage time until 21 days. The lowest moisture content are on 0 days storage time with 50.62% and the highest are on 21 days storage time with 57.15%. Indonesian National Standard (SNI) state that the maximum of moisture content on sausage are 67%, sausage with the addition of tomato paste still on standard range with 50.62% – 57.15%.

Moisture content are related to shelf life. The higher moisture content, the easier microorganism to growth. Moisture content are increased because of the metabolites of microorganism. Microorganism can effect on pectin degradation [14]. Pectin are tomato fiber that can bind water. When pectin lose the ability to bind water, meat product usually have a high moisture content and can caused a low texture [15].

3.4 Total Microorganism

Total microorganism of different storage time spent hen sausage with the addition of tomato paste are presented in Table 1. Very significant effect are shown in total microorganism ($P < .01$). Total microorganism slightly increased during storage time until 21 days. The lowest are on 0 days storage time with 0.08×10^3 CFU/g and the highest are on 21 days with 0.14×10^3 CFU/g. Indonesian National Standard (SNI) stated that the maximum of total microorganism on sausage are 1×10^5. sausage with the addition of tomato paste still on standard range.

Microorganism are correlated with moisture content and pH. The higher moisture content, microorganism tend to grow faster [16]. Microorganism are an important factor on meat product's shelf life. High microorganism can reduce the quality and shelf life of the product. The addition of tomato paste can slower the growth of microorganism because tomato contain a natural antioxidant which is carotenoid, ascorbic acid, and phenolic compounds [17].

The addition of natural antioxidant can slow down the growth of microorganism. Jeeyeon et al. [18] report that ascorbic acid from lemon can slow down *C. perfringens* on sausage. The other study are addition of eggplant powder on pork sausage. Addition of eggplant powder on sausage can minimalize microorganism metabolic because eggplant has a natural antioxidant namely phenolic and ascorbic acid [19].

3.5 Rancidity

Rancidity of different storage time spent hen sausage with the addition of tomato paste are presented in Table 1. Very significant effect are shown in peroxide value ($P < .01$). Peroxide value slightlyincreased during storage time until 21 days. The lowest are on 0 days storage time with 0.71 meq/kg and the highest are on 21 days with 1.12 meq/kg. Jinkyu et al. [20] report the standard of peroxide value in meat product that can still acceptable by consumer are under 25 meq/kg.

When peroxide value excess the standard, it can cause an off odor, off flavor, and off color. Fat and oxygen are the main factor of the peroxide value increased. Unsaturated fatty acid are sensitive into oxygen, light, and temperature. When unsaturated fatty acid meet oxygen it can lead a formation of hydroperoxide (ketones and aldehydes) and lead to fat oxidation [21]. To slow down the fat oxidation, antioxidant are needed. The use of tomato on spent hen sausage can slow down the fat oxidation because it has a natural antioxidant. Carotenoid, ascorbic acid, and phenolic compounds can destroy free radicals that can caused an oxidation [17]. Jouki et al. [22] report that the addition of tomato paste on frankfurter sausage slightly increase until 14 days of refrigerated storage time. Tomato paste can minimalize an oxidative reaction from fat because of antioxidant properties.

Table 1. Quality of Spent Hen Sausage with Different Storage Time

Variable	Treatments			
	D_0 ± SD	**D_1 ± SD**	**D_2 ± SD**	**D_3 ± SD**
pH	6.40 ± 0.04[a]	6.54 ± 0.02[b]	6.59 ± 0.02[b]	6.64 ± 0.04[c]
Lightness (L)	67.10 ± 0.05[b]	66.98 ± 0.06[b]	66.82 ± 0.05[a]	66.38 ± 0.52[a]
Redness (a*)	3.28 ± 0.12[c]	3.07 ± 0.04[c]	2.94 ± 0.06[b]	2.71 ± 0.07[a]
Yellowness (b*)	22.42 ± 0.02[c]	22.35 ± 0.04[c]	23.23 ± 0.05[b]	22.13 ± 0.06[a]
Moisture content (%)	50.62 ± 0.36[a]	53.21 ± 0.91[b]	54.78 ± 0.35[c]	57.15 ± 0.84[d]
Total Microorganism (CFU/g)	0.08 ± 0.70[a]	0.1 ± 0,44[a]	0.13 ± 0.32[b]	0.14 ± 0.21[b]
Peroxide Value (meq/kg)	0.71 ± 0.14[a]	0.84 ± 0.15[a]	1.02 ± 0.08[b]	1.12 ± 0.07[b]

a,b,c,d shows a very significant effect

4. CONCLUSION

Tomato paste are potentially being used for natural antioxidant. Addition of 15g tomato paste on spent hen sausage can extend spent hen sausage's shelf life until 21 days on refrigerated temperature (4˚C) based on pH, color analysis, moisture content, total microorganism, and peroxide value.

CONSENT (WHERE EVER APPLICABLE)

Author agreed to the publication of this manuscript.

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