Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 20, Issue 1, 2020
PRINT ISSN 2284-7995, E-ISSN 2285-3952

DETERMINATION OF CRITICAL POINT OF CHICKEN FILLET DAMAGE USING POLYETHYLENE PACKAGING AT 4°C STORAGE TEMPERATURE

Rosalina Ilmi AMALIA, Bunayya Rabbika FIRLY, Bella Alfiah SIMAMORA, Nurul SAKINAH, Tita RIALITA, Gemilang Lara UTAMA

University of Padjadjaran, Faculty of Agro-Industrial Technology, Jl. Bandung-Sumedang Km 21, Jatinangor, West Java, Indonesia, 45363, Emails: rosalinailmi@gmail.com, bunayya16001@mail.unpad.ac.id, bellaalfiah16008@mail.unpad.ac.id, nurul16037@mail.unpad.ac.id, trialita1@gmail.com, lugemilang@gmail.com

Corresponding author: lugemilang@gmail.com

Abstract

The use of plastic for packaging fillet chicken meat is known to not significantly inhibit the growth of microbial contaminants. One alternative solution to maintain the freshness of fillet chicken meat at low temperature storage (± 4^{O}C) is to use active packaging based on natural ingredients with the addition of antimicrobials. Based on this, the determination of the critical point of damage to fillet chicken meat during storage is important to know as a basis for comparison to determine the effectiveness of packaging applications in extending the shelf life of fresh chicken meat. This study aims to determine the critical point of damage to fillet chicken meat which is packaged using polyethylene (PE) type plastic and stored at a storage temperature of ± 4 °C. The study was conducted using descriptive methods, where fillet chicken meat was stored until characteristics are not favoured by panellists. Observation parameters consisted of acidity (pH), total number of microbial plate counts (TPC), colour change (ΔE), texture (elasticity), presence of Salmonella, Shigella, and Escherichia coli contamination, and the preference level test for colour, aroma and texture of chicken fillet. The results showed a critical point of damage to fillet chicken meat occurred on the 3rd day marked by a decrease in quality during storage, namely an increase in pH due to decomposition, an increase in the total number of microbes by 2 logs since the first day of storage, lightness on the meat was getting darker, and decreasing the value of the consistency of chicken fillet. Detection of Salmonella, Shigella, and E.coli bacterial contamination was negative on the first day, but was detected positive on the 3rd day. Panellists began rejecting fillet chicken meat on the 3rd day of storage based on the parameters of colour, aroma and texture of chicken meat.

Key words**:** *critical point, chicken fillet, polyethylene plastic, storage*

INTRODUCTION

Chicken broiler is a term commonly used to describe the results of animal husbandry technology cultivation that has economic characteristics with the characteristics of fast growth, as a producer of meat with economical food conversion and ready to cut at a young age of 35 - 45 days with a weight 1.2 - 1.9 kg / head [13]. The color of fresh chicken meat is yellowish with the characteristic aroma of broiler chicken meat that is not fishy, not slimy and does not cause a foul odor [12].

Nowdays, the citizen of Indonesia are more familiar with broiler chicken meat as chicken meat that is commonly consumed because of its advantages such as high content or nutritional value so that it is able to meet nutritional needs in the body, easily obtained, thicker meat, and has a more texture tender compared to free-range chicken meat and easily available on the market and supermarkets at affordable prices. However, due to its high nutritional content, it causes broiler chicken meat to be easily damaged due to the development of spoilage microorganisms which will reduce the quality of the meat so that the impact on the meat becomes easily damaged [12].

Generally, broiler chicken meat sell in the market without packaging, it make easier for spoilage microbes to contaminate broiler chicken meat, so that the broiler chicken meat will be damaged quickly. Some microorganisms that can cause damage and

decay in broiler meat are *Escherichia coli*, *Shigella*, and *Salmonella* [4].

Prevention of damage to chicken fillet is by packaging. the types of plastic packaging commonly applied to broilers are PP (Polyprophylen), PE (polyethylen), and plastic warp [11]. However, packaging of broiler chickens with PP, PE and Warp plastic is not able to protect broiler chickens optimally, because the number of microbes found in broiler chicken meat still exceeded the maximum limit of microbial contamination [19].

Therefore, to extend the shelf life of broiler fillet chicken, packaging is done using active packaging based on natural ingredients with the addition of antimicrobials and stored at refrigerator temperatures (±4 °C).

Active packaging is the incorporation of certain additive compounds into packaging films with the aim of maintaining or increasing the shelf life of the product [8]. The active ingredients in the form of antimicrobial function to delay microbial spoilage, minimize contamination, and maintain the color of the product during the storage process. Meanwhile, refrigerator temperature storage (± 4 °C) can slow down enzymatic performance and prevent the growth of spoilage microbes [17, 14].

Based on this, it is important to determine the critical point of damage to fillet chicken during storage as a basis for comparison to determine the effectiveness of active packaging applications in extending the shelf life of fresh chicken meat. This study aims to determine the critical point of damage to fillet chicken meat which is packaged using polyethylene (PE) type plastic and stored at a storage temperature of ± 4 ° C.

MATERIALS AND METHODS

The purpose of this research is to determine the critical point of chicken meat fillet which is packaged using polyethylene (PE) type plastic and stored at a storage temperature of ± 4 °C

The tools used in this study were stirring rods, beaker cups, petri dishes, colony counters, sensory shapes, scissors, hand chroma, incubators, refrigerators, pH meters, volume pipettes, knives, polyethylene plastic (PE), test tubes, texture analyzers, and vortex.

The materials used in this study were fillet chicken breast originating from Slaughtering house in the Rancaekek District, West Java-Indonesia, distilled water, buffer pH 4 and pH 7, broiler chicken breast fillet, Eosin Methylene Blue (EMB) agar media, Plate Count Agar (PCA) media, Salmonella-Shigella Agar (SSA) Media, and Physiological NaCl 0.85% sterile.

Preparation of Fillet Chicken Meat

Chicken breast fillets are cut into cubes with a size of ± 5 cm x 5 cm x 5 cm. Then, the chicken pieces are put into PE plastic. Samples are stored in the refrigerator at a temperature of ± 4 °C.

Organoleptic Test

Pieces of chicken fillet are tested hedonically every day by semi-trained panelists until the sample is damaged and panelists reject it. The quality parameters tested included color, aroma and texture.

Microbial Test

In microorganism testing, testing is done that is Total Plate Count, detection of Salmonella bacteria, Shigella, and detection of Escherichia coli bacteria contamination. The procedure performed was mashed chicken fillet, dissolved in 0.85% NaCl physiological sterile (1:9) in a test tube. Then the sample was homogenated by vortex, the suspension is a 10^{-1} dilution. Then, dilution is continued until 10^{-7}. Samples contained in 10^{-6} and 10^{-7} dilutions were incubated using SSA (for *Salmonella* and *Shigella* bacterial detection), EMB (*E.coli* bacterial detection and PCA (Total Plate Count for all kind of microorganism) media. SSA and EMB agar are incubation in temperature 37°C and PCA agar is incubation in temperature 30°C for 2 days.

Colour Test

First, the chroma-hand is prepared and calibrated. After being calibrated, a color test was carried out by detecting at 5 points on the surface of the fillet chicken pieces. The results of the hand chroma color test are sets of coordinates such as L *, a * and b *. L * values represent lightness, i.e. 0 for black and

100 for white, axis a * shows 28 intensities in red (+) or green (-), axis b * indicates intensity in yellow (+) or blue (-) [10].

Texture Test

First, a texture analyzer is prepared and a probe type P-36 is selected. After all texture analyzer components are installed, select TPA mode then calibrate it first, both calibration force and calibration height. After calibration, chicken pieces can be placed under the probe, then select Run A Test. The probe will compress the chicken meat. The results will be displayed on a computer display, both hardness, cohesiveness, adhesiveness, gumminess, springiness and chewiness. In this research just using springiness result.

pH Test

First, the pH meter is calibrated first with a buffer of pH 7 and followed by a buffer of pH 4. After the pH meter has been calibrated, chicken samples are prepared. Chicken pieces are weighed as much as 5 g for 25 ml of distilled water (1: 5 w /v). After weighing, the chicken pieces are chopped until fine and 25 ml of distilled water is added.

RESULTS AND DISCUSSIONS

Texture of Chicken Meat Fillet

Chicken meat texture was measured using the Texture Analyzer tool. This texture profile analysis is the most popular method used to predict the texture quality of chicken breast meat. Texture profile analysis (TPA) is a two-cycle compression test to determine texture attributes in food by mimicking the action of biting humans [5]. The texture parameters taken in this study are the Springiness value in chicken meat. Springiness is a value that indicates the extent to which the sample returns to its original form. The results of springiness testing in chicken meat can be seen in Fig. 1.

Broiler chicken meat packaged in polyethylene packages and stored at a storage temperature of ± 4°C has a springiness value that continues to decrease during storage. This decrease in springiness value indicates that chicken meat has changed its texture to become more soft or inelastic.

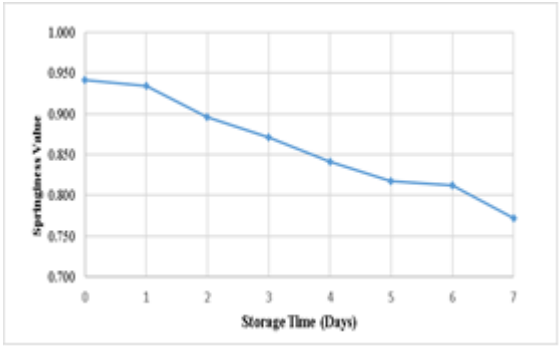

Fig. 1. Texture of Chicken Fillet
Source: Own data.

Changes in texture can also occur due to damage to some of the constituent connective tissue and filament threads in chicken meat as a result of biochemical changes and microbial activity [16]. Damage to these tissues causes loss of power to support the structure of chicken meat so that the texture of the meat has decreased. When the total number of microbes reached 10^8 CFU/g, decomposition of muscle tissue was evidenced by the formation of surface mucus [6].

Value of Acidity (pH)

The average pH of broiler chicken meat packaged with PE plastic packaging, and stored at a storage temperature of ± 4 ° C, is briefly presented in Fig. 2. The results showed a tendency to increase in pH value during storage of broiler chicken meat using PE type plastic.

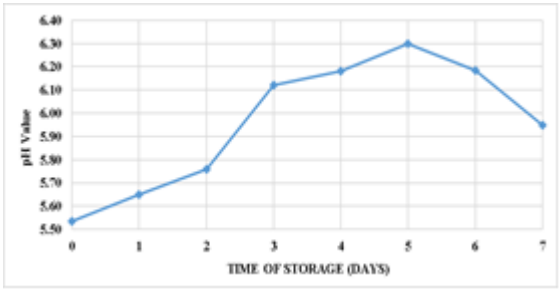

Fig. 2. Observation of pH
Source: Own data.

The increase in pH can be caused by the activity of spoilage microbes that produce ammonia, so that it is detected as OH^- value which can increase the pH value of broiler chickens. In addition, the increase in pH can also be caused by biochemical reactions in the post-mortem process of chicken meat.

Many factors cause an increase in the pH value of chicken meat. After slaughtering

chicken has a pH value that is not constant, the pH will decrease in the first hours of cutting, and will increase after experiencing postmortem [7, 9]. The increase in pH value in chicken meat is still in accordance with the Indonesian National Standard which states if the pH of a good chicken ranges between pH 6-7.

L * Value (*Lightness*)

L * or lightness values indicate the brightness of a sample with values ranging from 0 (black) to 100 (white). The average L * value in chicken meat packed with PE plastic and stored at ± 4 °C storage temperature decreased. The results of observing the L * value are presented in Fig. 3.

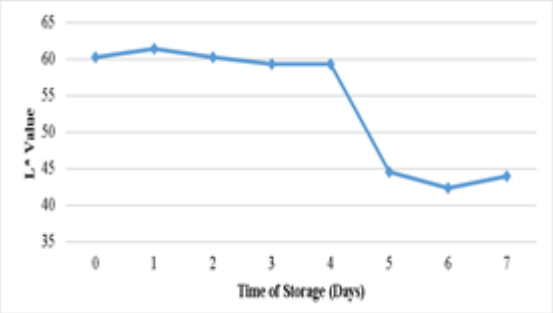

Fig. 3. L* Value
Source: Own data.

Decrease in L * value indicates if the color of the chicken is getting darker, this is due to the influence of the activity of microorganisms that cause the color of the chicken to get darker [2].

Value of a * (*Redness*)

Value of a* or redness values indicate the redness or greenness of a sample with values ranging from -60 (green) to +60 (red). The average value of a * in chicken meat during storage decreased, the results of observations are in Fig. 4.

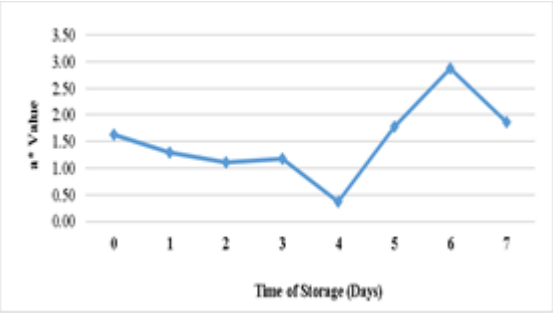

Fig. 4. Value of a*
Source: Own data.

The decrease in the value of a * indicates that the color of chicken meat is getting longer and more greenish storage period, this is due to the presence of hydrogen sulfide (H_2S) compounds produced by bacteria in meat. H_2S will react with air, blood pigment, and tissue pigment to form sulfmioglobin which is green [18].

Value of b * (Yellowness)

A value of b * or yellowness value indicates the yellowish or bluish level of a sample with values ranging from -60 (blue) to +60 (yellow) [3]. The average value of b* decreases during storage. The observations can be seen in Fig. 5.

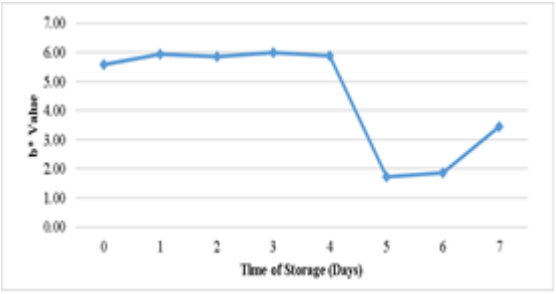

Fig. 5. Value of b*
Source: Own data.

A decrease in the value of b* can be caused by changes in meat pigment during storage. Storage at low temperatures for a long time causes methyoglobin to synthesize, which in general can change the color of meat [15].

Organoleptic Test

Organoleptic test on a product is very necessary to assess how much consumer interest in the food produced. This test was carried out to determine the assessment of the level of consumer preferences in terms of color, aroma, and texture of chicken packed with PE plastic and stored at ± 4 ° C. The observations are presented in Fig. 6.

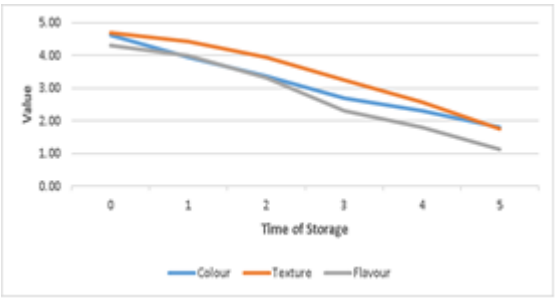

Fig. 6. Results of Organoleptic Test
Source: Own Data.

The observations stated that if the panelists began rejecting samples on the 3rd day of storage, from the test results, the longer the storage time, the more the panelists disliked the color, aroma and texture of the chicken, so the smaller the test value. Panelist dislike of the color, texture, and aroma of chicken meat is supported by other test data.

Amount Total of Microorganisms

Amount total of microorganism has purpose to find out whether the number of microbes in chicken meat is in accordance with the standards adopted by the Indonesian government or not. The test results are in Fig. 7.

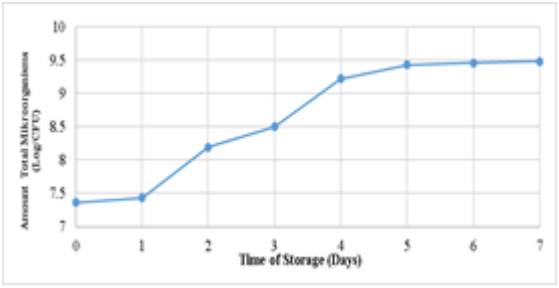

Fig. 7. Total Microorganisms
Source: Own data.

Observation results indicate if on day 0 of chicken meat storage, the number of microbial colonies in chicken meat has exceeded the Indonesian National Standard Agency (BSNI), which is 10^6 or 6 Log cfu/gr [1].

The total number of microbes in meat observed on day 0 was 7 log, and it increased until the 7th day of storage.

The high number of total microorganisms on the first day can be due to poor storage after the cutting process, so when testing the total number of microbes has exceeded the set standards.

***Salmonella, Shigella,* and *Escherichia coli* Bacterial Detection**

Salmonella, Shigella, and E.coli bacteria are three of the many bacteria that are used as indicators of damage to chicken meat.

This study examines the presence or absence of contamination of Salmonella, Shigella, and E.coli bacteria in chickens that are packed with PE packaging and stored at low temperatures.

The observations are presented in Table 1.

Table 1. Result of Bacterial Detection

Bacteria/ Time of Storage	Result	
	10^6	10^7
Salmonella dan Shigella/D0	Negative	Negative
Salmonella dan Shigella/D7	Positive	Positive
Escherichia coli/D0	Negative	Negative
Escherichia coli/D7	Positive	Positive

Source: Own Data.

Observations were obtained if the bacteria Salmonella, Shigella and E.coli were detected in the samples tested on the last day of storage, but were not detected at the beginning of the storage period. The undetectability of the three bacteria can be caused by the amount of dilution that is too large so that when the last day is observed, the results are positive for the three bacteria.

CONCLUSIONS

Chicken fillets that were given a packaging treatment using PE type plastic and stored at a storage temperature of ± 4 ° C only lasted for 3 days of storage. Decrease in quality during 4°C storage shown by the increase of pH and the total number of microbes by 2 logs, lightness on the meat was decrease and followed by decreasing of the chicken fillet consistency. Based on the color, aroma and texture of chicken fillet, panellists began to dislike it since the 3rd day of storage.

REFERENCES

[1]Badan Standardisasi Nasional (National Standardization Agency), 2009, SNI 3924:2009 Mutu Karkas dan Daging Ayam. Dewan Standardisasi Nasional. Jakarta. (SNI 3924: 2009 Quality of Carcass and Chicken Meat. National Standardization Board. Jakarta).
[2]Barbut, S., 2002, Poultry Products Processing. An Industry Guide. CRC Press. Florida.
[3]Barbut, S., 2015, The Science of Poultry and Meat Processing. University of Guelph. Canada.
[4]Bhunia, A.K., 2008, Foodborne Microbial Pathogens: Mechanisms and Pathogenesis.
[5]Bourne, M.C., 1978, Texture Profile Analysis. Food Technology 32(7): 62-67 &72.
[6]Charles, N., Williams, S. K., Rodrick, G. E. 2006, Effect of Packaging System on The Natural Microflora

and Acceptability of Chicken Breast Meat. Poultry Science 85, 1798-1801.
[7]Debut, M., Berri, C., Bae´za, E., Sellier, N., Arnould, C., Guemene, D., Jehl, N., Boutten, B., Jego, Y., Beaumont, C., Le Bihan-Duval, E., 2003, Variation of Chicken Technological Meat Quality in Relation to Genotype and Preslaughter Stress Condition. Poultry Science. Vol. 82:1829–1838. France.
[8]Dobrucka, R., Cierpiszewski, R., 2014, Active and Intelligent Packaging Food-Research And Development: A Review. Polish Journal Food Nutrition Sciences 64(1): 7-15.
[9]Duclos, M. J., Berri, C., Le Bihan-Duval, E., 2007, Muscle growth and meat quality. J. Appl. Poultry Res. 16:107–112.
[10]Fabre, C.E., Goma, G., Blanc, P.J., 1993, Production and Food Applications Of The Red Pigments of *Monascus ruber*. Journal of Food Science 58 (5): 1099-1102.
[11]Irawati, N., Neneng, Y.H., 2014, Penggunaan Kemasan Plastik Jenis PE (*Polythylene*), PP (*Polypropylene*) dan Plastik *Wrap* terhadap Angka Kuman pada Daging Ayam. Jurnal Kesehatan. Universitas Dian Nuswantoro. Semarang. (Use of PE (Polythylene), PP (Polypropylene) and Plastic Wrap Type of Germs on Chicken Meat. Journal of Health. Dian Nuswantoro University. Semarang).
[12]Kasih, N.S., Jaelani, A., Firahmi, N., 2012, Pengaruh Lama Penyimpanan Daging Ayam Segar Dalam Refrigerator Terhadap pH, Susut Masak Dan Organoleptik. Media Sains (Effect of Long Storage of Fresh Chicken Meat in Refrigerator on pH, Shrinkage and Organoleptic Shrinkage. Science Media), 4 (2): 154-159.
[13]Priyatno, M. A., 2003, Mendirikan Usaha Pemotongan Ayam. Penebar Swadaya, Jakarta (Establishing Chicken Slaughtering Business. Penebar Swadaya, Jakarta).
[14]Risnajati, D., 2010, Pengaruh Lama Penyimpanan dalam Lemari Es terhadap pH, Daya Ikat Air, dan Susut Masak Karkas Broiler yang Dikemas Plastik Polyethylen. Jurnal ilmu (Pet Effect of Storage Duration in the Refrigerator on pH, Water Bonding Capacity, and Shrinkage of Broiler Carcass Cooking Packaged by Polyethylene Plastic. Journal of Pet Sciences).13 (6):309-315.
[15]Saucier, L., Gendron, C, Gariepy, C., 2000, Shelf Life of Ground Poultry Meat Stored Under Modified Atmosphere. Poultry Sci. Canada
[16]Soeparno, 2009, Ilmu dan Teknologi Daging. Cetakan V. Gadjah Mada University Press. Yogyakarta (Meat Science and Technology. Matter of V. Gadjah Mada University Press. Yogyakarta)
[17]Wuryanti, 2004, Isolasi dan Penentuan Aktivasi Spesifik Enzim Bromelin dari Buah Nanas (*Ananas comosus* L.). Artikel: JKSA, (Isolation and Determination of Specific Activation of Bromelin Enzyme from Pineapple (Ananas comosus L.). Article: JKSA), 7(3): 83-87
[18]Yulistianti, R., 2010, Studi Daging Ayam Bangkai: Perubahan Organoleptik dan Pola Pertumbuhan Bakteri. Jurnal Teknologi Pertanian (Chicken Carcasses Study: Organoleptic Changes and Bacterial Growth Patterns. Journal of Agricultural Technology). Vol 11, 27-36.
[19]Zhang, Q.Q., Han, Y. Q., Cao, J. X., Xu, X. L. Zhou, G. H., Zhang, W. Y., 2014, The Spoilage Of Air-Packaged Broiler Meat During Storage At Normal and Fluctuating Storage Temperatures. Poultry Science 91:208–214.