Original Research Article

Changes in the Quality of Culled Layer Chicken Meat at Different Ultrasonic Time Levels

ABSTRACT

Aims: This study aims to determine changes in the quality of culled layer chicken meat at different ultrasonic time levels based on Cooking loss, pH, Electrical Conductivity (EC), Tenderness and Color L*a*b*. the material used is culled layer chicken meat which has been ultrasonic.

Study design: The method used in this research is experimental laboratory using Completely Randomized Design (CRD) with 5 treatments and 4 replications.

Place and Duration of Study: Animal Product Technology Departement, Faculty of Animal Science, University of Brawijaya, Malang, Indonesia, between September-November 2022

Methodology: Ultrasonic treatment for 10 minutes (P1), 15 minutes (P2), 20 minutes (P3), 25 minutes (P4), and 30 minutes (P5). Parameters observed were Cooking loss, pH, Electrical Conductivity (EC), Tenderness and Color. Data were analyzed using Analysis of Variance (ANOVA). if the data showed a significant difference, continued with Duncan's Multiple Range Test (DMRT).

Results: The average cooking loss value is 2.24-4.07; pH 6.21-6.40; EC 0.61-0.76; tenderness 6.9-10.8; color L* 45.79-51.62; a*6.30-6.54; b* 12.56-13.19.

Conclusion: The results showed that ultrasonic treatment with a different time in culled layer chicken meat had no significant effect (P>0.05) on the pH, EC, color but could have significant

Keywords: ultrasonic, culled layer, meat, quality

1. INTRODUCTION

Food technology is currently developing rapidly. Several innovations were carried out aimed at maintaining the quality of the products to be marketed to meet consumer demand. One of these methods used to process foods is high power ultrasonic. Ultrasonic is a form of energy generated by a sonic pressure wave with a frequency greater (above 20 kHz) than the upper limit of the human hearing range. Based on frequency range, ultrasonic is divided into two categories as low (low intensity) and high power energy (high-intensity) (Jayasooriya et al., 2004; Awad et al., 2012; Turantas et al., 2015). The applications for which high power ultrasonic can be used range from existing processes that are enhanced by the retro-fitting of high power ultrasonic technology, to the development of processes up to now not possible with conventional energy sources (Patist and bates, 2008). Applications of ultrasonic at high intensities to provoke changes in physical and chemical properties of meat and meat products (Jayasooriya et al, 2004). The aim of this paper is to review the effects of power ultrasonic on the technological properties and quality of culled layer chicken meat.

2. MATERIALS AND METHODS

The ingredients used in this research were: culled layer chicken meat, distilled water, and buffer solutions 4 and 7. The tools used in this research were: ultrasonic bath, cutting board, erlenmeyer, measuring cup, analytical balance, beaker glass, stirrer, label, EC meter, knife, zip lock bag transparent, warner-blatzler, colorimeter and pH meter.

2.1. Sample Preparation

Culled layer chicken meats were purchased from a layer farm in Pakis. Then, the samples were closely wrapped in a plastic box. The samples were stored in the freezer (≤ -18°C). Before that, the skin and fat were separated so that only the meat remained, then the culled layer chicken meat was cut into 1x1x2 cm^3.

2.2. Ultrasonic Process

The ultrasonic process used an ultrasonic bath with a sample of 50 g culled layer chicken meat. The sample was put into a zip lock bag transparent then were processed in an ultrasonic bath with the length of time according to the treatment that had been determined P1 (10 minutes), P2 (15 minutes), P3 (20 minutes), P4 (25 minutes) and P5 (30 minutes).

2.3. Analysis procedure

2.3.1. Cooking loss Test

Cooking losses were calculated from the time course of water content in the sample. The cooking loss was calculated by measuring the difference in weight between the ultrasonic samples and raw samples as follows: $\frac{\text{weight loss}}{\text{initial fresh meat weight}}\ x\ 100\%$

2.3.2. pH Test

pH or potential of hydrogen is an indication of meat quality based on the degree of acidity to express acid or base. The measurement method is the tool is calibrated with a buffer at pH 4 and pH 7. Samples of 5 g culled layer chicken meat were crushed then 25 ml distilled water was added and stirred until it became homogeneous then measured using a pH meter.

2.3.3. Electrical Conductivity Test

The electrical conductivity (EC) is determined by measuring the concentration and mobility of ion. 5 gram of sample was homogenized with 50 ml of distilled water, stirred until homogeneous and waited for 15 minutes, then measured using an EC meter.

2.3.4. Tenderness Test

The tenderness test used a sample of culled layer chicken meat that has been ultrasonic and has been cut 1 x 1 x 2 cm^3 Measurement of tenderness value used the warner bratzler tool.

2.3.5. Color Test

Color was measured on the surface area of culled layer chicken meat for three replicates of upper, middle and lower areas. Instrumental color measurements by using colorimeter and was reported in the CIE color system (L*a*b*).

2.4. Data Analysis

Data analysis results were performed by using ANOVA (Analysis of Variance). If the data showed a real or very real test, then it was continued with the multiple distance duncan test.

3. RESULTS AND DISCUSSIONS

Table 1. Effect ultrasonic treatment on cooking loss, pH, EC, tenderness and color.

Physical properties	P1	P2	P3	P4	P5
Cooking loss (%)	2.24±0.72^{a}	2.87±0.69^{ab}	3.06±0.71^{ab}	3.26±0.80^{ab}	4.07±0.67^{b}
pH	6.21±0.21	6.23±0.15	6.32±0.16	6.32±0.18	6.40±0.36
EC (m/s)	0.61±0.09	0.69±0.06	0.76±0.11	0.75±0.11	0.69±0.05

Tenderness (N)	10.8±0.71^{a}	9.075±0.86^{b}	9±0.89^{c}	7.65±0.51^{c}	6.9±0.08^{d}
L*	51.62±3,83	50.92±2.53	49.49±3.69	51.13±4.50	45.79±2.39
a*	6.54±1,25	6.48±0.94	6.45±0.45	6.34±0.62	6.30±0.35
b*	12.56±1.66	12.65±0.51	12.67±3.61	12.76±0.88	13.19±1.15

3.1. Cooking loss

Table 1 showed that the result of the cooking loss test on culled layer chicken meat had significant effect (P<0.05) ranging from 2.24 to 4.07. The highest average cooking loss value was 4.07 at P5 (with ultrasonic treatment time of 30 minutes) and the lowest average was 2.24 at P1 (with ultrasonic treatment time of 10 minutes). Cooking loss in chicken increased when heating time was increased (Christensen et al, 2012). But Alarcon-Rojo et al (2015) reported that ultrasonic has a significant effect to reducing cooking losses without affecting other quality parameters. This is presumably because the treatment of time and ultrasonic power was given are different.

3.2. pH

Table 1 showed that the result of the pH test on culled layer chicken meat had no significant effect (P>0.05) ranging from 6.21 to 6.40. The highest average pH value was 6.40 at P5 (with ultrasonic treatment time of 30 minutes) then the lowest average was 6.21 at P1 (with ultrasonic treatment time of 10 minutes). Variations in pH value are influenced by muscle glycogen reserves, ultimate meat pH, stress before slaughter, distribution of certain hormones and medicine, individual livestock, muscle type, electrical stimulation, and enzyme activity (Sari et al, 2017). In a study of the effect of high frequency ultrasonic on physical properties of muscles meat generally pH increased with increasing ageing time and ultrasonic treatment (Jayasooriya et al, 2007).

3.3. EC

Table 1 showed that the result of the EC test on culled layer chicken meat had no significant effect (P>0.05) ranging from 0.61 to 0.76. The highest average EC value was 0.76 at P3 (with ultrasonic treatment time of 20 minutes) then the lowest average was 0.61 at P1 (with ultrasonic treatment time of 10 minutes). Electrical conductivity (EC) is a measurement of the total ion concentration in the solution (Hershey and Sand, 1993; Kaewthong and Wattanachant, 2018). The radicals and ions induced by ultrasonic radiation contributed to the increase of EC in food during sonication (Castellanos, et al 2001; Zhang et al, 2015)

3.4. Tenderness

Table 1 showed that the result of the tenderness test on culled layer chicken meat had a very significant effect (P<0.05) ranging from 6.9 to 10.8. The highest average tenderness value was 10.8 at P1 (with ultrasonic treatment time of 10 minutes) then the lowest average was 6.9 at P5 (with ultrasonic treatment time of 30 minutes). High-power ultrasonic has been shown to effectively increase the tenderness of meat by causing disruption of the muscle integrity and modifying the structure of collagen (Alarcon-Rojo et al, 2015). high-intensity ultrasonic radiation coupled with enzyme treatment improves meat tenderness by causing disruption in muscle integrity but also its proteolytic activity (Barekat and Nafiseh, 2017).

3.5. Color

Table 1 showed that the result of the color test on culled layer chicken meat had no significant effect (P>0.05) ranging from L*45.79 to 51.62 a* 6.30 to 6.54 b* 12.56 to 13.19. The current results were partly in agreement with the reports of Jayasooriya, et al (2007) that ultrasonic treatment had no significant effect on any of the color parameters L*a*b*. A rise in temperature with ultrasonic treatment assisted with tenderisation, the heat generated may have been insufficient for thermal denaturation and oxidation of the colour pigment myoglobin into metmyoglobin (Martens et al, 1982; Jayasooriya et al, 2007). High-power ultrasonic can lead to a rise in temperature of muscle, and heated muscle has been found to be lighter and less red in color than fresh muscle, because of thermal denaturation of myoglobin and hemoglobin color pigments (Pohlman et al. 1997; Chang et al, 2012). Denaturation of myoglobin reduces the red color of meat (King & Whyte, 2006; Christensen et al, 2012).

4. CONCLUSIONS

The results showed that ultrasonic treatment with a different time in culled layer chicken meat had no significant effect (P>0.05) on the pH, EC, color L*a*b* but could have significant effect on the cooking loss and a very significant effect on the tenderness.

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