

THE EFFECT OF DUCK MEAT MARINATION WITH VARIOUS CONCENTRATIONS OF GREEN TEA EXTRACT (*Camellia sinensis*) ON PHYSICAL, MICROBIOLOGICAL AND ACCEPTABILITY PROPERTIES

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Abstract

Green tea (*Camellia sinensis*) contains active compounds such as tannins, flavonoids, epicatechins and catechins. This compound has the potential to reduce pH and inhibit bacterial growth, so the use of green extract as a marinade of duck meat is suspected to extend the shelf life. Moreover, the ability to reduce pH might affect physical properties, even though the use of green tea at high concentrations is suspected to reduce acceptability because the aftertaste green tea has. The study aimed to find out the effect of various concentrations of green tea extract on physical, microbiological and acceptability properties, as well as to obtain the best concentration of green tea extract for marination. The study was conducted experimentally, using a Completely Randomized Design (CRD) with 4 immersion treatments for 10 minutes with green tea extract concentrations of 2.5%, 5%, 7.5% and without green extract. Each treatment was repeated 5 times to obtain 20 experimental units. The measured variables were water holding capacity, cooking loss, tenderness, pH, total bacteria, shelf life, and acceptability (color, aroma, taste, and total acceptance). The results showed that the construction of green tea extract had an influence on microbiological quality, but did not affect physical and acceptability properties, except for the color. The best concentration used for marinating duck meat was 5% of green tea extract.

Key words: duck meat, green tea, physical properties, microbiology, acceptability

INTRODUCTION

The high fat level on duck meat, especially unsaturated fatty acids tends to provide duck meat in producing off-flavor. Unsaturated fatty acids that affect off-flavor include C18: 2 (15.1 - 19.3%); C18: 1 (31.5 - 35.7%); C16: 0 (21.8 - 22.0%) [11]. Flavor is one of the important sensory properties that can affect the acceptability (organoleptic) of food [19].

The handling to prevent off-flavor, reduce fishy odor, increase tenderness and storability of duck meat can be done by adding natural ingredients with active compounds, including green tea (*Camellia sinensis*). Green tea has been known as a potential source of antioxidants that are beneficial to health because the compounds

in tea leaves contain antioxidant called epigallocatekin-galat (EGCG) and other catechin [25].

The high nutritional content of duck meat has a high risk of bacterial growth and breeding, so preservation efforts are needed, one of which uses natural green tea preservatives. The active components contained in tea, both volatile and nonvolatile, are polyphenols, methylxanthines, amino acids, peptides. Other organic components, tannic acid, vitamin C, vitamin E, vitamin K, β -carotene, potassium, magnesium, manganese, fluorine, zinc, selenium, copper, iron, calcium, caffeine [15]. Vitamin C contained in EGCG green tea extract can reduce the pH of meat because it is acidic. Acidic properties can result in protein denaturation in meat, so it will affect the physical quality of meat, including tenderness which will affect water holding capacity and cooking loss.

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Green tea contains tannin compound consisting of catechins, luekoantioacin and gallic acid, cafeic acid and chlorlorogenate and esters of these acids, namely 3-galloilepikatechin, phenylcafeate et cetera. Tannin is a phenol compound that can damage polypeptides of cell wall and will inactivate host cell molecules[1]. The same thing was stated by [14]that phenol compounds are antimicrobial.

The results of previous studies showed that green tea extract concentrations of 5% can reduce the total pathogenic bacteria, such as *Shigella dysenteriae*, *Salmonella sp*, *Escherichia coli*, *Staphylococcus aureus*, and *Listeria monocytogenes*[4],[17],[27]. Soaking chicken meat with green tea extract with a concentration of 5% for 10 minutes can increase the shelf life indicated by inhibition zones bacteria in *E. coli*, *S. aureus*, *S. typhoid*, *Bacillus* [16]. Against beef, green tea extract with a concentration of 2.5% for 10 minutes showed decrease in *S. aureus*, *L. monocytogenes*, *S. typhimurium*, and *E. Coli*, lipid degradation, and color stability[12]. Based on this description, it is necessary to do research on the effect of marinating duck meat with green tea extract (*Camellia sinensis*) on physical, microbiological and acceptability properties.

MATERIAL AND METHOD

The material used was carcass of thigh parts from 20 ducks and 500 grams of dried green tea leaves. The chemicals used were nutrient agar (HIMEDIA, India), distilled water, Pb Acetate, salin water, fat cotton, filter paper, and label paper.

Extraction of tea extract

Dried green tea leaves were dissolved into hot aquadest (temperature 90-100°C) according to the treatment, namely 0 grams of green tea in 600 ml of aquadest (P1), 15 grams of green tea in 600 ml of aquadest (P2), 30 grams of green tea in 600 ml aquadest (P3), and 45 grams of green tea in 600 ml of aquadest (P4), after steaming it was allowed to sit out for 10 minutes at room temperature, then it could be filtered to obtain green tea extract.

The variables observed in the study are as follows:

Total bacteria

Total bacterial testing on meat used the total bacterial calculation method [6]

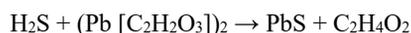
$$\text{Total bacteria (cfu/gr)} = \text{total colonies} \times \frac{1}{\text{diluent factor}}$$

Degree of acidity (pH)

Measuring the acidity (pH) of the meat was done using a pH meter.

Shelf Life

Determination of meat shelf life used the early stage of decomposition method [9], which uses Pb acetate. The principle of Pb acetate was H₂S formed from green tea extract marinated duck meat which was then captured by lead acetate on filter paper with a reaction:



It formed lead sulfide (PbS) that caused stains on filter paper.

Water Holding Capacity

Measurement of water holding capacity using [9] the formula:

$$\text{WHC} = \text{water content} - \left(\frac{\text{mgH}_2\text{O}}{300\text{mg}} \right) \times 100\%$$

$$\text{mg H}_2\text{O} = \frac{\text{wet area (cm}^2\text{)}}{0,0948} \cdot 8$$

$$\text{water content} = \frac{w_2 - w_3}{w_3 - w_1} \times 100 \%$$

$w_2 - w_3$ = (weight of cup + sample after oven) - (weight of cup + sample) = weight loss of water in the sample.

$w_3 - w_1$ = (weight of cup + sample) - weight of cup = sample weight

Cooking Loss

Calculation of cooking loss referred [21]as follows:

$$\text{Cooking loss} = \frac{w_1 - w_2}{w_1} \times 100 \%$$

w_1 = weight before cooked duck meat

w_2 = weight after duck meat after cooking

Tenderness

The tenderness test using a penetrometer referred to [25] by looking at the depth

penetration of the penetrometer needle into duck meat for 10 seconds.

$$\text{Tenderness} = \frac{\text{average measurement}}{10 \text{ second}}$$

Sensory Analysis

Sensory analysis (taste, color, odor) were assessed according to the Descriptive method of Hedonic, using 20 well-trained panelists from the Faculty of Animal Husbandry, Padjadjaran University with 7 rating scales : 7= very much liked, 6=like a lot, 5 = liked, 4 = liked and did not like, 3 = dislike, 2 = much dislike, 1 =very much dislike [22].

Statistical analysis

The research was conducted experimentally in a laboratory using a Completely Randomized Design (CRD) with 4 treatments of green tea extract concentration levels based on meat weight as follows: P0 (soaking meat in 0% green tea extract), P1 (soaking meat in 2.5% tea extract green, P2 (soaking meat in 5.0% green tea extract), and P3 (soaking meat in 7.5% green tea extract. Statistical analysis of acceptability used Kruskal-Wallis non parametric test and if there were significant differences, it was followed by Man Whitney test.

RESULTS AND DISCUSSIONS

Table 1 Antimicrobial Activity of LAB Isolates Againsts Various Pathogen

Parameters	The marination in green tea extract			
	0%	2.5%	5.0%	7.5%
Total bacteria (10 ⁶ cfu/g)	162 b	91 ab	42 a	96 ab
pH	5.99 a	5.99 a	5.83 a	5.85 a
Early decomposition (minute)	308 b	469 a	554 a	552 a

Means in the same row followed by different letters indicates significant differences (p < 0.05)

The data in Table 1 shows that the total bacterial treatment of the best duck meat immersion of 5% concentration of green tea extract is significantly different (P <0.05) compared with 0% green tea extract (P1). The ability of green tea increases the shelf

life is caused by the content of tannins and flavonoids that work as antibacterial. The mechanism of tannin compound as antibacterial is by shrinking the cell wall or cell membrane, thus disrupting the permeability of the cell itself [2].

Table 2 Effect of Treatment of Physical Characteristics of Duck Meat

Parameters	The marination in green tea extract			
	0%	2.5%	5.0%	7.5%
WHC (%)	35.47 a	44.84 a	40.00 a	40.34 a
Cooking loss (%)	44.33 a	44.28 a	46.55 a	43.97 a
Tenderness (mm/g/10 detik)	123.56 a	124.06 a	128.36 a	134.54 a

Means in the same row followed by different letters indicates significant differences (p < 0.05)

Besides that, flavonoids in green tea have the ability to denature proteins, so bacterial cell metabolic activity stops because all bacterial cell metabolic activities are catalyzed by an enzyme, which is a protein, resulting in bacterial cell death [26]. The results of this study are in line with [16] that soaking chicken meat with green tea extract with a concentration of 5% for 10 minutes can increase the shelf life indicated by the

inhibition zone in *E. coli*, *S. aureus*, *S. typhoid*, *Bacillus*.

The acidity (pH) of duck meat after it was soaked in 0 - 7.5% concentrations of green tea extract is not significantly different. This is due to the same pH of the green tea and the meat, namely the pH of the green tea extract solution at various concentrations ranging from 5.6 to 5.9 is relatively the same as the pH of duck meat, which is 5.6 - 5.94[20].



Thus the solution of green tea extract cannot change the pH of duck meat. Soaking duck meat in green tea extract significantly extended the storage time ($P < 0.05$) without green tea extract 0% (P1), but not significantly different from the concentrations of 5% and 7.5%. This is because of the active substance tannins in green tea. According to [5] tannins are phenolic polymer compounds that have antimicrobial properties and toxic to bacteria.

Effect of Green Tea Extract on the Physical Properties of Duck Meat

The results of marinating duck meat in green tea extract on the physical properties of duck meat are listed in Table 2.

The data in Table 2 shows that the soaking concentrations of green tea extract (0%, 2.5%, 5.0% and 7.5%) do not have any significant effect ($P > 0.05$) on the physical properties of duck meat (water holding capacity, cooking loss and tenderness). This shows that the active compounds in green tea extract (tannins and flavonoids) in various treatments have the same effect on the physical properties

of duck meat (water holding capacity, cooking loss and tenderness).

Based on the results of the study that the water holding capacity produced is not significantly different, so that the result of cooking loss is also not significant. The cooking loss of duck meat with green extract concentration treatment (0, 2.5, 5.0 and 7.5%) in the range of 43.97% - 46.55% is still in the normal category. This is in accordance with the opinion of [13], that generally cooking loss values are between 1.5-54.5% with the range of 15-40%. Meat with lower cooking loss has a relatively better quality compared to the meat with a higher cooking loss, because of less nutrient loss while cooking [21].

The tenderness of meat is related to water holding capacity and cooking loss. The results of previous studies of the water holding capacity showed that the treatments of various concentrations of green tea extract were not significantly different, which resulted in tenderness was not significantly different as well as. According to [21] that the higher water holding capacity, the tenderness level is also higher in meat.

Effect of Green Tea Extract on Duck Meat Acceptability

Table 3 Effect of Treatment of Physical Characteristics of Duck Meat

Parameters	The marination in green tea extract			
	0%	2.5%	5.0%	7.5%
Color	30.0 a	41.5 ab	50.4 b	41.5 ab
Flavor	36.1 a	39.3 a	43.6 a	43.0 a
Taste	33.5 a	40.9 a	45.4 a	42.3 a

Means in the same row followed by different letters indicates significant differences ($p < 0.05$)

The data in Table 3 shows that soaking duck meat in green tea extract has a significant influence on the color of duck meat, but does not have a significant effect on aroma and taste. The most preferred color of duck meat in the soaking treatment of 5% green tea extract had a significant effect ($P < 0.05$) compared to without soaking green tea extract, but did not significantly affect of green tea extract 2.5% and 7.5%. The color of the meat produced in the treatment without green tea extract immersion is normal, which

is white and while soaking with 5% green tea extract the color of the flesh turns into a slightly brownish color. This is due to the presence of antisionin compounds in green tea extract, resulting in significantly different meat colors ($P < 0.05$) on the treatment of 0% green tea extract.

Anthocyanin is a compound that is highly reactive, easily oxidized or reduced, and glycoside bonds are easily hydrolyzed[10]. Color degradation in anthocyanin is caused by changes in flavylium cations which are

red to carbinol bases and eventually become colorless chalcones and end up in the degradation of brown products [18]. According to [7] that tea extract at higher concentrations is a good inhibitor of lipid damage, but unable to maintain the color of the meat.

Scent assessment is a subjective assessment that requires sensitivity in feeling and smelling. The statistical analysis results (Table 4) showed that soaking duck meat in various concentrations of green extract 0%, 2.5%, 5.0% and 7.5% did not affect of duck meat flavor. This might be due to the cooking process, the distinctive aroma of duck meat which is the presence of fishy smell is more dominant than the aroma of green tea. The fishy smell of duck meat is due to the high fat content in duck meat, which is 8.2% [23]. The aroma of meat is strongly influenced by precursors which are soluble in water and fat, as well as the release of volatile substances (volatiles) contained in meat. This according by [24] that the smell of meat is caused by the presence of a volatile fraction in the form of inosin-5-monophosphate (a result of the conversion of adenosine-5-triphosphate to living muscle tissue) containing hydrogen sulfide and methyl mercaptan.

Soaking meat with various concentrations in green tea extract had no significant effect ($P > 0.05$) on duck meat taste. Based on the data (Table 4) it appears that the taste of duck meat with the use of green tea extract at various concentrations does not significantly give any difference to the taste. This might be due to the distinctive taste of green tea covered with spices (salt), given so as not to affect the taste of duck meat. Taste is influenced by several factors including chemical compounds, concentration, temperature and interactions with other taste components. Seasoning plays an important role in the formation of the taste of meat. Spices play a role in the formation of flavor which is reinforced by the presence of cooking. According to [21] the taste in meat is influenced by the meat ingredients added, the cooking method especially the high temperature and the length of cooking and seasoning.

CONCLUSIONS

The marination of duck meat in green tea extract (*Camellia sinensis*) has an effect on total bacteria, early decomposition, and color, but does not affect pH, water holding capacity, cooking loss, tenderness, acceptability of flavor and taste.

The best physical, microbiological and acceptability properties of duck meat could be obtained by marinating the duck meat in 5% green tea extract for 10 minutes.

REFERENCES

- [1] Afiyah, D.N. 2013. Sifat Mikrobiologi Sosis Daging Sapi dengan Penambahan Ekstrak Daun Jati (*Tectona grandis*) Selama Penyimpanan Dingin. Institut Pertanian Bogor.
- [2] Ajizah, A., 2004. Sensitivitas *Salmonella typhimurium* terhadap Ekstrak Daun *Psidium Guajava* L. *Bioscientiae* Vol.1 No.1. 8-31
- [3] Buckle, K.A., R.A. Edwards, G.H. Fleet and M. Wooton. 1985. Ilmu Pangan. UI-Press. Jakarta.
- [4] Chou, C.C., L.L. Lin and K.T. Chung. 1999. Antimicrobial Activity of Tea as Affected by The Degree of Fermentation and Manufacturing Season. *International Journal of Food Microbiology* 48(2):125-130
- [5] Cowan, M.M. 1999. Plant Products as Antimicrobial Agents. *Clinical Microbiology Reviews* 12:82. 564.
- [6] Denny, W.L., P. Trioso, S. Minarwati, W.S. Agatha, L. Hadri, S. Roso. 2009. Higiene Pangan, Fakultas Kedokteran Hewan Institut Pertanian Bogor. Departemen Kesehatan dan Kesejahteraan Sosial Republik Indonesia
- [7] Haghparast S, Kashiri H, Alipour G, Shabanpour B. 2011. Evaluation of Green Tea (*Camellia sinensis*) Extract and Onion (*Allium cepa* L.) Juice Effects on Lipid Degradation and Sensory Acceptance of Persian Sturgeon (*Acipenser persicus*) filets: a comparative study. *J Agr Sci Tech.* 13:855-868.
- [8] Hamm, R. 1972. *Kolloidchemie des Fleisches-des Wasserbindungsvermoegeen des Muskeleiweisses in Theories und Praxis.* Verlag Paul Parey, Berlin. In; Soeparno. 2005. Ilmu dan Teknologi Daging. Cetakan Ke-Empat. Gadjah Mada University Press, Yogyakarta.
- [9] Hario, P.S. 1998. Analisis Kualitas Susu dan Daging. Penerbit Universitas Airlangga, Surabaya
- [10] Hutching, J. B. 1999. Food Colour and Appearance. Gaitersburg, Maryland: Aspen Publ. Inc
- [11] Kim, G.D., J.Y. Jeong., S.H. Moon, Y.H. Hwang, G.B. Park and S.T. Joo. 2006. Division of Applied Life Science, Graduate School,

- Gyeongsang National University, Jinju, Gyeongnam 660 – 701, Korea. pp. 1 – 3.
- [12] Kristanti, R. A., Hadibarata T., and Pumbusayukul N. 2014. Beneficial effects of commercial Assam green tea infusion on the microbial growth and oxidative stability of cooked beef. *International Food Research Journal* 21(4): 1313-1320
- [13] Lawrie, R. A., 2003. Ilmu Daging. Edisi Kelima. Terjemahan: A. Parakkasi. Penerbit Universitas Indonesia, Jakarta.
- [14] Naidu, A.S and Clemens, R.A. 2000. Natural Food Antimicrobial System: Probiotik. CRC press. New York
- [15] Pambudi, J. 2009. Potensi Teh sebagai Sumber Zat Gizi dan Peranannya dalam Kesehatan. Jakarta: Lembaga Riset Perkebunan Indonesia, Departemen Kesehatan dan Kesejahteraan Sosial RI.
- [16] Pranali K., Bhatte S., Ghayal M. 2014. *Camellia sinensis* as a Natural Meat Preservative in Association with its Total Polyphenol Content. *International Journal of Thesis Projects and Dissertations (IJTPD)*. Vol.2, Issue 3,: 32-36.
- [17] Sakanaka, S., Juneja, L.R. and Taniguchi, M. 2000. Antimicrobial Effects of Green Tea Polyphenols on Thermophilic Spore Forming Bacteria. *Journal of Bioscience and Bioengineering* 90(1):81-85
- [18] Sari, P., F. Agustina, M. Komar, Unus, M. Fauzi dan T. Lindriati. 2005. Ekstraksi dan Stabilitas Antosianin dari Kulit Buah Duwet (*Syzgiumcumini*). *Jurnal Teknologi dan Industri Pangan*, XVI (2): 142-146.
- [19] Shahidi, F. 1998. Flavor of Meat, Meat Product and Seafoods. 2nd Edition. Blackie academic and Profesional, Canada, 291p.
- [20] Smith D. P., D. L. Fletcher, R. J. Burhr, R. S. Beyer. 1993. Peking duckling and broiler chicken pectoralis muscule strukture and composition. *J Poul Sci* 72 :202-208.
- [21] Soeparno. 2009. Ilmu dan Teknologi Daging. Gajah Mada University Press, Yogyakarta
- [22] Soewarno, T. Soekarto. 1981. Penilaian Organoleptik Untuk Industri Pangan Dan Hasil Pertanian. Bhatara Karya Aksara. Jakarta
- [23] Srigandono B. 1997. Beternak Itik Pedaging. Gajah Mada University Press, Yogyakarta.
- [24] Suardana, I W. dan Swacita, I.B.N., 2009. Higiene Makanan. Udayana Uneversity Press, Denpasar, Bali.
- [25] Sulisty J., Nurdiana., dan H. Elizar. 2003. Pengembangan Kerja Sama Riset, Teknologi Produksi, dan Pemasaran Produk Hilir Teh. Prosiding "Simposium Teh Nasional 2003". Bandung. Pusat Penelitian Teh Kina Gambung
- [25] Tien, R. Muchtadi dan Sugiyono. 1992. Petunjuk Laboratorium Ilmu Pengetahuan Bahan Pangan. IPB: Bogor. 52-53; 62-63.
- [26] Trease, G. E., and W. C. Evans. 1987. *Pharmacognosy*, 11th Edition. Bailliere Tindall. London: 401-403.
- [27] Wan X, Li D, dan Zhang Z. 2008. Antioxidant Properties and Mechanism of Tea Polyphenols. *Nutraceutical Science and Technology, Tea and Tea Products. Chemistry and Health-Promoting Properties*. 8(8) : 131-159.