APPLICATION OF GREEN TEA EXTRACT AS AN ANTIOXIDANT AND EXTENDS SHELF-LIFE IN RAW BEEF STEAK

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Abstract – The aims of this study were to investigate effects of green tea extract supplementation as an antioxidant on lipid oxidation and antimicrobial activity in raw beef steak during storage. The beef steaks were divided into 4 groups with different concentrations of green tea extract treated at 0, 4, 8 and 12 g/kg of meat. All samples were packed in vacuum bags and kept under 4 ºC for 3 weeks. Sampling was performed after adding green tea extract at 0 day, 1, 2 and 3 weeks. Psychotropic bacteria, antioxidant activity (% radical scavenging activity) and lipid oxidation (TBARS) were examined. The results displayed that psychotropic bacteria number in all groups were increased during storage time with the highest number in control group. The percentages of radical scavenging activity values in treated groups were higher than control. TBARS values in green tea groups were lower than control. This study found that green tea extract as a natural antioxidant could be used in raw beef steak for extend shelf life and antioxidant property.

Key Words – Green tea extract, beef, antioxidant

I. INTRODUCTION

Recently, consumer concerns have focused more on functional food. One method to reach healthier food is adding substances with beneficial properties (5). Utilization of plant extract, particularly green tea extract, is an alternative to chemicals against foodborne pathogens, inhibiting lipid oxidation and thus extend the shelf life. This is an increasing trend in food industry, including meat, sausages and fish (8). Green tea (*Camellia sinesis* L.) has been reported to have numerous health benefits such as antioxidant, inhibit lipid oxidation, antimicrobial and anticarcinogenic properties (8, 9). In addition, more reports found that the frequent consumption of green tea may protect against cardiovascular disease and different types of cancer (3). Currently, meat lovers often consider meat quality in term of microbial contamination and lipid oxidation which lead to undesirable meat appearance (7, 9, 11). Moreover, consumers also focus on healthier meat. Therefore, the aims of this study were to investigate the application of green tea extract to improve quality and produce healthier meat.

II. MATERIALS AND METHODS

Preparation of green tea extract

Green tea extract in powder form was obtained from Mahidol University, Thailand. Each 100 mg of green tea powder contained cathechins 12.94 mg (catechins 3.65 mg, epicatechin 3.65 mg, epicatechin gallate 2.31 mg and epigallocatechins gallate 1.82 mg). *Semitendinosus* whole muscle (n=4) was cut into 4 pieces. Green tea extract was added to pieces of beef at 0, 4, 8 and 12 g/kg (powder/meat) and stored in chill room at 4 °C for 0, 1, 2 and 3 weeks.

Detection of psychotropic bacteria

Psychotropic bacteria numbers were determined by using plate count agar (Merck, Germany) and incubated at 7 °C for 10 days (1) and expressed as $\log_{10}$ cfu/g of meat.

Measurement of Antioxidant activity and lipid oxidation

1,1- Diphenyl-2-Picrylhydrazyl Radical-Scavenging Assay (DPPH)

The antioxidant property was determined using DPPH assay expressed as a percentage of radical scavenging activity (10).

2-Thiobarbituric Acid –Reaction Substance

Lipid oxidation was measured by 2-thiobarbituric acid method using the distillation technique and expressed as TBARS (thiobarbituric acid reactive substance) number in the unit of mg malondialdehyde/kg meat (modified from (2)).

Statistic analysis

The design of experiment was a Randomized Completely Block Design (RCBD). Data were analyzed using ANOVA. Differences of means were separated by Duncan's New Multiple Range Test (DMRT) using SAS.

III. RESULTS AND DISCUSSION

Effect of green tea extract on psychotropic bacteria

The effect of different concentrations of green tea extract on psychotropic bacteria was determined. It was found that number of psychotropic bacteria increased with storage time. However, the rate of microbial growth was lower in beef steaks with added green tea extract. The number of psychotropic bacteria in beef steaks with green tea added at 8 and 12 g were significantly lower than the control group ($P< 0.05$) as shown in Table 1. Many studies report that green tea had inhibitory effects on foodborne pathogens and food spoilage bacteria such as *Salmonella* Typhimurium, *Salmonella* Typhi, *Shigella dysenteriae, Yersinia enterocolitica, E. coli, Staphylococcus aureus, Campyrobacter jejuni* and *Pseudomonas aeroginosa* (4). In addition, Pilasombut *et al*. (6) found that antimicrobial activity of green tea extract inhibited *Listeria innocua, Brochotric campestris, S. aureus* and *Aeromonas hydrophila* (*in vitro*) . As a result, an application of green tea extract could be beneficial for antimicrobial in refrigerated beef steaks.

Effect of green tea extract on antioxidant activity and lipid oxidation

The antioxidant properties and lipid oxidation of beef steaks were analyzed after adding green tea extract at concentration of 0, 4, 8 and 12 g/kg to meat. It was demonstrated that the percentage of radical scavenging activity in beef with added green tea extract was higher than control ($p<0.05$). In addition, percentage of radical scavenging activity gradually increased in beef steak with higher concentrations of green tea extract added. However, there were no significant differences in percentage of radical scavenging activity in beef with green tea added at 8 and 12 g/kg (Table 2). TBARS values decreased as higher concentrations of green tea extract were added. Hence, green tea extracts reduced lipid oxidation in beef steak during 3 weeks of storage time (Table 3). These results were similar to Jo *et al.* (5) who found that TBARS values of pork patties with green tea leaf extract powder added (0.1%) were significantly lower than the control. In addition, the radical scavenging effect of raw pork patties significantly increased when compared to control group. Ellinger *et al*. (3) reported that green tea is rich in flavonols which has strong antioxidant properties. While, Perumalla *et al*. (8) concluded that tea catechins displayed high antioxidant properties against lipid oxidation in meat.

Table 1 Effect of green tea extract on psychotropic bacteria in beef steak

Concentration	Psychotropic bacteria (log cfu/g)			
	Week 0	Week 1	Week 2	Week 3
0 g/kg	4.52	5.24[a]	6.04[a]	6.59[a]
4 g/kg	4.90	5.24[a]	6.02[a]	6.54[a]
8 g/kg	4.86	4.79[b]	5.96[a]	6.30[b]
12 g/kg	4.46	4.23[c]	5.56[b]	6.29[b]

[a-c] The means with different superscripts in a column are significantly different ($p < 0.05$)

Table 2 1,1-Diphenyl-2-picrylhydrazyl (DPPH)-scavenging activity (%) of raw beef steak

Concentration of green tea	Storage time			
	Week 0	Week 1	Week 2	Week 3
0 g/kg	28.043[c]	28.963[b]	30.109[b]	29.253[b]
4 g/kg	72.928[b]	90.020[a]	84.112[a]	85.389[a]
8 g/kg	90.746[a]	90.218[a]	89.015[a]	89.326 [a]
12 g/kg	91.477[a]	90.726[a]	90.090[a]	90.053 [a]

[a-c] The means with different superscripts in a column are significantly different ($p < 0.05$)

Table 3 Effect of green tea extract on lipid oxidation (mg malondialdehyde/kg meat)

Concentration of green tea	TBARS (mg MDA/kg)			
	Week 0	Week 1	Week 2	Week 3
0 g/kg	0.123[a]	0.125[a]	0.128[a]	0.130[a]
4 g/kg	0.121[b]	0.123[b]	0.124[b]	0.127[b]
8 g/kg	0.119[c]	0.121[c]	0.123[c]	0.125[c]
12 g/kg	0.118[c]	0.120[d]	0.121[d]	0.122[d]

[a-d] The means with different superscripts in a column are significantly different ($p < 0.05$)

IV. CONCLUSION

Green tea extract displayed inhibition of psychotropic bacteria and lipid oxidation on beef steaks stored for 3 weeks. In addition, green tea extract also showed significant antioxidant properties in beef steaks. Therefore, it was indicated that adding green tea extract, a natural antioxidant and antimicrobial, to fresh beef proved to be strongly effective in increasing shelf life.

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