Green tea extract alters the functional properties of meat emulsions by generation of protein cross-links
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Publication date:
2014

Document Version
Early version, also known as pre-print

Citation for published version (APA):
GREEN TEA EXTRACT ALTERS THE FUNCTIONAL PROPERTIES OF MEAT EMULSIONS BY GENERATION OF PROTEIN CROSS-LINKS

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Objective
To determine the dose-dependent effects of green tea extract as a natural phenolic antioxidant on the oxidation and functional properties of meat emulsions.

Introduction
Intermolecular disulphide bonds via oxidation of protein thiols play an essential role for the gel strength of heat-induced muscle protein gels (1, 2), by enhancing the rheological and mechanical properties of the gel matrix (3).

Phenolic antioxidants reduce oxidation and lipid-derived off-flavor formation during production and storage of meat products. However, studies have shown that phenolic compounds are able to react with thiol groups to form covalent thiol-quinone adducts (TQ-adducts) (4).

Quinones are generated when phenols are oxidized and have been shown to reduce total thiol concentration in beef stored under high-oxygen modified atmosphere (5) and in Bologna-type sausages (6).

It is suspected that TQ-adducts impair the gel-forming ability of the meat proteins, as it was recently found that addition of green tea extract, added as a natural antioxidant, altered the textural properties of Bologna-type sausages as detected by a sensory panel (6).

Methods and Materials

Recipe of meat emulsions
275 g of pence L
12.5 g NaCl
100 g crushed ice
100 g carbon oil
0.05, 0.25, or 0.75 g Green Tea extract (GT20A, DuPont, Denmark)

Methods

Procedure

Recipe of meat emulsions
275 g of pence L
12.5 g NaCl
100 g crushed ice
100 g carbon oil
0.05, 0.25, or 0.75 g Green Tea extract (GT20A, DuPont, Denmark)

Procedure

Tubes filled with batter, centrifugation 3000 rpm, 10 min. Heated in water bath (80 °C) until a center temperature of 70 °C (~15 min). Cooked on ice – hereafter cooling has analysis. Kept at 5 °C for 1 day – hereafter remaining analyses.

Analyses

Emulsion stability evaluated by cooking loss
Cooking loss was determined directly after heat treatment and centrifugation at 2700 g for 3 min by weighing the supernatant. Supernatant (g) / Meat batter (g) × 100 % = Cooking loss (%), w/w.

Textural properties evaluated by shear force

Sample were cut into 2-3 cylindrical cores and placed on a platform and each sample compressed to 30 % of its original height (strain) using an Instron Material Testing Machine (Instron 4301, Instron, Bucks, UK).

Shear force

Cooking loss

Lipid oxidation

Protein cross-links

Figure 1. Cooking loss (% w/w) in meat emulsions added 0 (Control), 100, 500, or 1500 ppm green tea extract (GT) at day 0 (n=3). Secondary lipid oxidation products as determined by TBARS (umol/dm) in the same meat emulsions stored at 5 °C for 1 day (n=3).

Figure 2. Hardness (N) and Crumbliness (Strain (%)) of meat emulsions added 0 (Control), 100, 500, or 1500 ppm green tea extract (GT) stored at 5 °C for 1 day (n=3).

Figure 3. Protein band pixel intensity before or after reduction by diithothreitol (DTT) of myosin heavy chain (MHC) from meat emulsions added 0 (Control), 100, 500, or 1500 ppm green tea extract (GT) stored at 5 °C for 1 day (n=3).

Conclusions

• Green tea extract protected against lipid oxidation at all applied concentration levels
• Cooking loss and textural properties were altered as a result of increased protein cross-linking when 1500 ppm Green Tea extract was applied
• On the contrary, 100 ppm Green Tea extract reduced protein disulfide cross-linking and still protected against lipid oxidation

References