Evaluation of shelf life of ginger powder injected biceps femoris under sous vide cooking and extended refrigerated storage

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Introduction: The shelf life of a meat product refers to a specific time when the product remains safe for human consumption while retaining desirable sensory, chemical, and physical attributes (Eustace et al., 2014). The extent of microbial growth and oxidation of lipids impacts the shelf life of the meat and its products. Cooking processes enhance palatability while also killing heat-sensitive microbes making food safe for consumption. Sous vide, low-temperature long time cooking, is a globally popular method of meat processing providing uniform texture and improved tenderness in meat (Naqvi, Thomson, et al., 2021). Sous vide combined with ginger protease enhanced the quality of low-value meat (Naqvi, Campbell, et al., 2021). It enhances microbial safety (Díaz et al., 2008), and also prevents lipid oxidation (Ayub & Ahmad, 2019; Roldan et al., 2014) which is one of the major causes of product deterioration resulting in significant loss of meat quality. This study aimed to evaluate the shelf life of ginger powder injected biceps femoris from older cows cooked under sous vide and stored at 4 ℃ for 10 weeks.

Materials and methods: This study comprised of six muscles bicep femoris (BF) obtained from older animals. Each muscle was divided into two parts that were randomly assigned as control (no injection) and treatment (injection treatment with ginger powder solution). The treatment samples were injected with 2g/L ginger powder solution at the rate of 16 % of the weight of the meat sample. Each control and treated meat piece was cut into five steaks that were randomly assigned for one of the storage (4 ℃) treatments; 0, 2, 4, 8 and 10 weeks post-cooking analysis. All samples were vacuum-packed and cooked at 65 °C for 1 h, and 8 h under sous vide. Raw and cooked BF were assessed for lipid oxidation through thiobarbituric acid reactive substances (TBARS) assay, and microbiological culturing was performed for raw and sous vide cooked meat after cooking (0 weeks) and under refrigerated storage of cooked meat for 2, 4, 8 and 10 weeks. The microbiological analysis was performed for aerobic plate count, Lactic acid bacteria, Brochothrix thermospacta, Clostridium perfringens, Salmonella spp, Listeria spp and yeast and moulds on raw and cooked meat samples stored for 10 weeks in refrigeration.

Results: Raw BF showed bacterial count ranged between 0.5-over 4 log10 cfu/g while sous vide cooking reduced the bacterial count substantially below the detection limit for 4 weeks after cooking. Microbial counts for selected bacteria including Lactic acid bacteria, Brochothrix thermospacta and Clostridium perfringens were detected between 4 and 5 log10 cfu/g at 8 and 10 weeks storage (4 ℃). There was no growth detected for Salmonella spp, Listeria spp and yeast and moulds after cooking and under refrigerated storage for ten10 weeks.

Higher TBARS ($P = 0.05$) were seen in GP injected samples 0.38 ± 0.05 (mg MDA/kg) compared to control samples 0.19 ± 0.02 (mg MDA/kg) in raw meat. TBARS increased with increasing cooking time ($P = 0.05$) in both control (1 h; 0.28 ± 0.02, 8 h; 0.34 ± 0.03) and injection treated samples (1h; 0.25 ± 0.02, 8 h; 0.32 ± 0.03). A significant interaction ($P < 0.001$) was also observed between injection treatment and storage duration. TBARS reduced to 0.19-0.2 mg MDA/kg in both control and injected samples in 2 weeks storage (4 ℃), followed by an increase in TBARS at 4, 8 and 10 weeks storage.

Conclusion: Sous vide cooking for 1 h and 8 h effectively reduced the microbiological counts at 65 ℃ below the detection limit for 4 weeks regardless of the injection treatment for biceps femoris from older animals. However, lipid oxidation increased in control and reduced in GP injected samples after cooking for 2 weeks.

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References:

Ayub, H., & Ahmad, A. (2019). Physiochemical changes in sous-vide and conventionally cooked meat. International Journal of Gastronomy and Food Science, 17, 100145.

Díaz, P., Nieto, G., Garrido, M. D., & Bañón, S. (2008). Microbial, physical–chemical and sensory spoilage during the refrigerated storage of cooked pork loin processed by the sous vide method. Meat Science, 80(2), 287-292.

Eustace, I., Gardner, G., Hildebrandt, A., Huynh, L., Jenson, I., Johnston, M., Kaur, M., Langbridge, J., Miles, D., & Ross, T. (2014). Shelf life of Australian red meat.

Naqvi, Z. B., Campbell, M. A., Latif, S., Thomson, P. C., McGill, D. M., Warner, R. D., & Friend, M. A. (2021). Improving tenderness and quality of M. biceps femoris from older cows through concentrate feeding, zingibain protease and sous vide cooking. Meat Science, 180, 108563.

Naqvi, Z. B., Thomson, P. C., Ha, M., Campbell, M. A., McGill, D. M., Friend, M. A., & Warner, R. D. (2021). Effect of sous vide cooking and ageing on tenderness and water-holding capacity of low-value beef muscles from young and older animals. Meat Science, 175, 108435.
Roldan, M., Antequera, T., Armenteros, M., & Ruiz, J. (2014). Effect of different temperature–time combinations on lipid and protein oxidation of sous-vide cooked lamb loins. Food Chemistry, 149, 129-136.