

NITRITE EMBEDDED VACUUM PACKAGING IMPROVES RETAIL CHARACTERISTICS OF BISON STEAKS

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Abstract - Bison meat is prone to rapid discolouration under aerobic retail packaging conditions and may be improved through use of a vacuum-sealed film containing embedded sodium nitrite (NIT; 113 mg·m⁻²; FreshCase®). Steaks fabricated from forty bison bulls were overwrapped with oxygen permeable polyvinyl chloride film (CONT) or NIT packaged and evaluated in retail for 4 d. A three way interaction was observed among packaging type, whole muscle ageing time and time in retail for objective (L*, hue and chroma), subjective (lean and surface discolouration) and myoglobin pigment colour measures ($P < 0.05$). CONT packaged meat had increased discolouration after 4 d in retail, while NIT meats did not. NIT packaging effectively improved the colour stability of bison meat under retail conditions.

Key Words: FreshCase®, meat colour, muscle pigment, packaging systems

I. INTRODUCTION

Bison (*Bison bison*) meat is valued as an alternative high protein lean meat. However, fresh bison meat discolours faster than beef at retail [1] potentially due to the higher pigment concentration and polyunsaturated fat content promoting oxidative instability in the meat [2]. A reduction in colour stability in bison may result in costly losses to retail revenue due to discounts, salvage of whole cuts into grind or discarded product. Recently developed packaging technology [3] incorporates small quantities (25-113 mg·m⁻²) of sodium nitrite into packaging film to promote nitrosylation of the myoglobin to form nitrosomyoglobin, which is bright red in colour. The aim of the present study was to determine if the problem of early retail browning in bison can be mitigated using FreshCase® packaging film.

II. MATERIALS AND METHODS

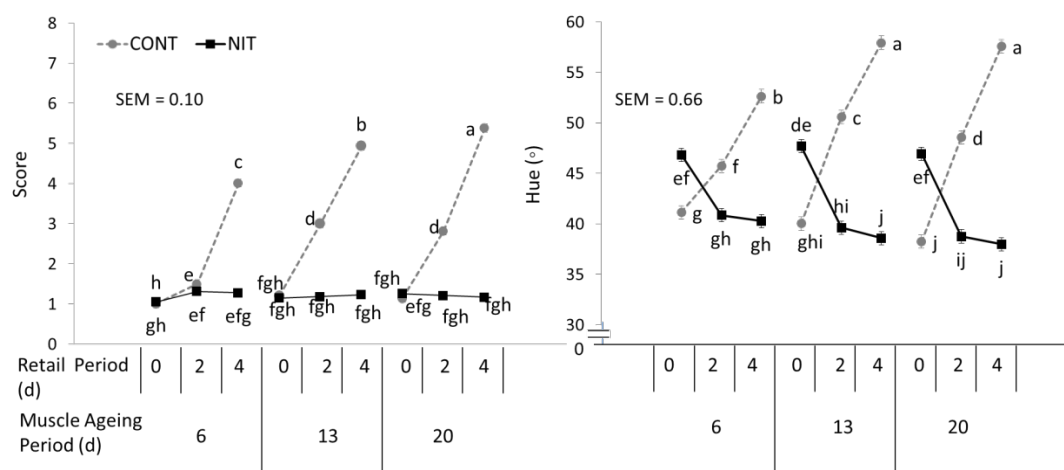
Longissimus lumborum (LL) from bison carcasses (n=40) were fabricated 48 h post-mortem into three equal portions (approximately 10 cm) and assigned to a refrigerated ageing period of 6, 13 or 20 d. Following ageing, 2.5 cm LL steaks were either packaged in a polystyrene tray over-wrapped with a polyvinyl chloride oxygen permeable film (8000 ml·m⁻² 24 h⁻¹; CONT) or in a polyethylene tray and vacuum skin packaged with 113 mg·m⁻² nitrite embedded vacuum skin oxygen impermeable film (FreshCase®; Curwood Inc., Oshkosh, WI; NIT) using a Multivac Tray Sealer T200. At 0, 2 and 4 d of retail display, steak objective colour (CIE L*, hue angle and chroma) was assessed in triplicate. Steaks were subjectively evaluated by an expert 5-member sensory panel for percent surface discolouration using a 7-point scale (1=0%; 2=1-10%; 3=11-25%; 4=26-50%; 5=51-75%; 6=76-99 % and 7=100% discolouration). Data were analyzed using a Mixed Effects Model (SAS software, Copyright © 2009, SAS Institute Inc.), with the packaging treatment and whole muscle ageing duration as main effects; time in retail as a repeated measure, and individual carcasses and side×carcass as random factors.

III. RESULTS AND DISCUSSION

The subjective discolouration scores for steaks showed a significant three way interaction between packaging×whole muscle ageing×retail display period ($P < 0.0001$; Figure 1). Surface discolouration values for CONT steaks significantly increased during retail display and the extent of discolouration was greater with longer whole muscle ageing. After 4 d under retail conditions, CONT steaks had scores corresponding to more than 50% surface discolouration during retail display, while NIT steaks remained largely unchanged. Hue measures obtained from the steaks showed a three way interaction effect between packaging×whole muscle ageing×retail display period ($P < 0.001$). For all ageing periods at 0 d under retail conditions, the CONT packaged steaks presented higher values of L* and chroma (not shown) but lower Hue values, indicating a more vivid red colour than NIT. However, after 4 d

under display conditions, the NIT steaks had significantly higher L* but lower Hue values (more bright red colour) than CONT; particularly after 13 d and 20 d of muscle ageing. The present results are largely in agreement with the improved colour stability in beef treated with nitrite in vacuum packaged systems for beef [4]. Bison meat in NIT packaging also has lower bacterial growth relative to PVC oxygen permeable overwrap; however, this effect was attributed to the anaerobic packaging conditions not the sodium nitrite present in the film [5]. Therefore in addition to improved colour stability, NIT can be utilized to increase the shelf life of bison meat [6].

Figure 1: Discolouration scores and hue (°) colour measures obtained from bison steaks in NIT or CONT packaging through a 4 d retail display following 6, 13 or 20 d of ageing. Means within the same measurement not sharing a common letter were significantly different ($P < 0.05$).



IV. CONCLUSIONS

The use of NIT packaging appeared to be an effective means of reducing discolouration in bison steaks. However, the increased time required for bison meat to brighten relative to CONT suggests this packaging strategy might be well suited for centralized packaging prior to shipment out to retail. Utilizing a centralized packaging of bison meat with NIT may allow sufficient time for the meat to lighten and allow retailers to display meat at or near optimal appearance.

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