EFFECT OF FROZEN STORAGE (UP TO 24 WEEKS) AT DIFFERENT TEMPERATURES ON BEEF LOIN EATING QUALITY

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Abstract – Here, comparable beef m. *longissimus lumborum* samples were kept frozen (at -12 °C or -18 °C) for 0, 4 and 24 weeks, before a consumer sensory panel evaluated their eating qualities. No significant difference was observed, suggesting -12 °C could be used instead of -18 °C for the long-term frozen storage of beef.

Key Words –Freezer, Temperature, Sensory characteristics.

I. INTRODUCTION

Beef is exported between distant markets where assurances of its quality on delivery are imperative. In response, long-term frozen storage has been applied to preserve beef throughout this interim between processing and consumption and is already considered a viable strategy to inhibit microbial and biochemical spoilage [1]. However, there remains a relative paucity of research exploring frozen storage holding temperature effects on beef quality [2] which if fulfilled could allow industry to adopt more cost-effective practices – as 'warmer' frozen storage temperatures are cheaper to maintain. Therefore, we aimed to test the effects of frozen storage (up to 24 weeks) at two different holding temperatures on beef loin eating quality traits using a consumer sensory panel.

II. MATERIALS AND METHODS

At 24 h post-mortem, eight random beef *m. longissimus lumborum* (LL) were selected from an export abattoir boning room; sectioned into three equal portions (n = 24); and individually vacuum-packaged as per Australian commercial abattoir practice. All LL portions were stored together for 5 weeks in on-site chilled storage (~ 0.5 °C) before then being assigned to one of three frozen storage periods (0, 4 or 24 weeks) at either -12 °C or -18 °C in duplicate freezers (two freezers per treatment). At the completion of their assigned frozen storage period, each LL was thawed overnight under refrigeration (3-4 °C) and then sectioned into five slices (thickness: 1.5 cm) which were then halved to generate ten 'bite sized' pieces per sample (n = 240) for sensory evaluation.

Sensory testing was adapted from [3] and involved three sessions of ten untrained consumer panelists. Each panelist first blindly evaluated a blank piece to familiarize them to the task, and then proceeded to test eight sample pieces – this number was selected to limit panelist fatigue and halo effects. Sample pieces were served and cooked ten at a time, using an electronic clam grill (GR-4A, Cuisinart™ Griddler, mean setting: 212.7 °C measured using a HACCP infrared thermometer; Model 8838, AZ Instrument Corp., Tiachung City, Taiwan) until medium doneness was achieved (71 °C internal temperature). Panelists were directed to score each piece in terms of its tenderness, juiciness, flavor and overall liking using a 0 to 100 sliding scale wherein 0 was the negative and 100 the positive ends of the response spectrum. Panelists also categorically ranked sample piece quality as; 1 = awful; 2 = unsatisfactory; 3 = good everyday quality, 4 = better than every day; and 5 = premium. Between samples, panelists cleansed their palettes with water and dry crackers. Demographic information pertaining to panelist age, smoking status, familiarity with red meat, preferred cooking level, income, occupation and household population were also collected.

Data were analysed using a linear mixed model under *R* [4] where frozen storage duration, freezer temperature, frozen storage duration x freezer temperature, and panelist sex, age, household population, income, preferred cooking level and familiarity with red meat were fitted as fixed effects. Panelist occupation, LL, LL portion, LL x portion x slice, and session x panelist were fitted as random effects. Level of significance was set at P = 0.05, and fixed effect terms not significant at this level were removed using backward stepwise regression. The remaining effects were then fitted in an analysis of variance under *R*.

III. RESULTS AND DISCUSSION

Freezing rate and method can both influence beef eating qualities [1] but were standardised so frozen holding temperatures could be compared. Within this context, temperature was observed not to influence any beef eating quality traits when held for either 4 or 24 weeks frozen storage ($P < 0.05$) suggesting the warmer -12 °C could be employed instead of -18 °C without diminishing its consumer and market appeal. Furthermore and independent to storage treatment, consumer age and familiarity with red meat were shown to be significant in their ranking of eating quality ($P < 0.05$) and doing so, reflected past research [5].

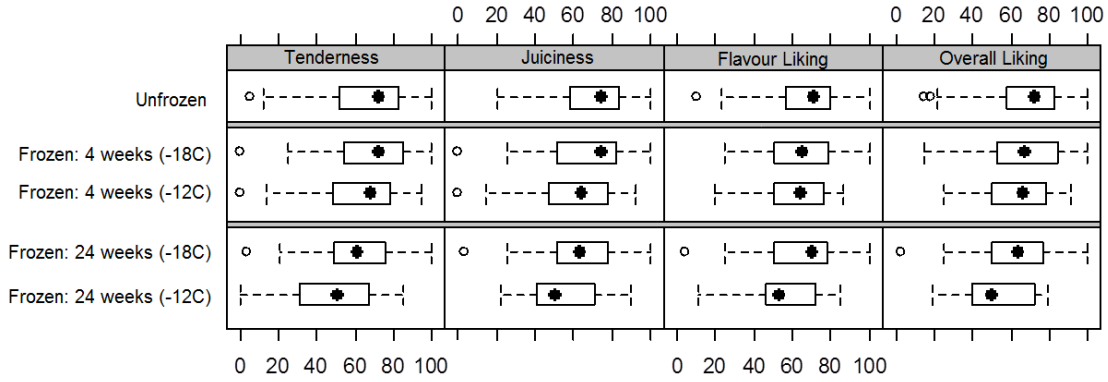

Figure 1. The boxplots of beef eating quality traits, across frozen storage temperatures and within sessions. The x-axis refers to a 0-100 sliding scale where 0 and 100 were the respective negative and positive quality extremes.

IV. CONCLUSION

Consumers were found not to perceive eating quality differences between beef LL kept frozen at -12 °C and -18 °C regardless of duration. That said, the data analysed in this study was performed separately for each eating quality trait, and given their high correlation it was difficult to differentiate between them. The inclusion of additional data could overcome this limitation and permit more multivariate analysis. Consequently, this study acts as a solid foundation that will prompt further complementary research.

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