BUSHFIRE EXPOSURE IS ASSOCIATED WITH DARKER COLOUR OF BEEF LOIN AT GRADING

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I. INTRODUCTION

The effect of bushfires on the Australian livestock industry extends beyond the direct loss of animals and farming assets, with the incidence of dark meat colour defects anecdotally increased in bushfire affected livestock (dark meat colour is defined as AUSMEAT colour score > 3 [1]). Dark meat colour defects result in downgrading of beef carcases to manufacturing meat and subsequently reduced returns for producers. The aim was to establish the association between fire exposure and meat colour and inform the development of strategies for mitigating the impact of bushfire on meat quality.

II. MATERIALS AND METHODS

The investigation used fire affected beef cattle data (n = 451 299) with MSA (Meat Standards Australia) records on the carcases from 2 fire seasons (2018-2019, 2019-2020) and 6 processing plants. Animal and property location data was collated with temporal geospatial data on fire proximity, days of fire exposure and pasture biomass. Animals were considered to have fire exposure if a fire had occured within 50km of their originating property in the 180 days prior to processing. MSA factors utilised in the model included feed type (grass or grain), HGP (hormonal growh promotant) usage (yes or no), sex (male or female), ossification (as an indicator of animal age), and hump height (mm, an indicator of *Bos indicus* content). The model development strategy using ultimate pH data is described in Hastie et al. [2]. AUSMEAT meat colour is scored 1 to 7, with 1 having three subclasses of 1A, 1B and IC; as the score increases the colour becomes darker [1]. Meat colour scores were converted into a continuous variable, with colour score 1B converted to ‘0’ and meat colour score 1C converted to ‘1’ (There were no carcases with meat colour score 1A), with colour scores 2 to 7 retaining their original value. Linear mixed models were fitted for loin colour score at grading in R version 4.0.2 with fire exposure, pasture biomass, animal, carcase variables and their interactions as fixed effects. The hierarchical random effects model was based on the structure of the data set, and included ‘consignment’ nested within ‘processing date’ nested within ‘processing plant’.

III. RESULTS AND DISCUSSION

The variables and interactions that were included in the final model and used to calculate the predicted colour scores in Figure 1 are (estimates, SED, P-value); Intercept 1.774 for feed type = grain, HGP = no, sex = female (SED=0.1725), log pasture biomass (0.02787, 0.003832, <0.001), log days fire (0.02420, 0.006925, 0.108), distance from fire km (-0.01452, 0.000804, <0.001),feed type = grass (0.0735, 0.02851, <0.001), HGP = yes (0.2289, 0.01900, <0.001), sex = male (-0.03933, 0.004867, <0.001), ossification (0.001807, 0.0000232, <0.001), hump height mm (0.002958, 0.0001065, <0.001), distance from fire x feed type = grass (0.01475, 0.000880, <0.001), log days of fire x HGP=yes (-0.02637, 0.007558, 0.001). Figure 1 (based on the final model presented above)

demonstrates that production factors can exacerbate the effect of fire exposure on beef colour with both grass feeding and HGP usage driving higher colour results as fire exposure increases. Overall, the least susceptible sample group for dark colour is (1) grain-fed no HGP treatment (equivalent to 35% of cattle in this study) followed by (2) grain-fed with HGP treatment (23% of the study group), (3) grass-fed no HGP treatment (6.5% of the study group) and (4) grass-fed with HGP treatment (36% of the study group) being the most susceptible. Furthermore, increasing ossification and hump height increased colour score (darkness) and male animals were lighter than female animals.

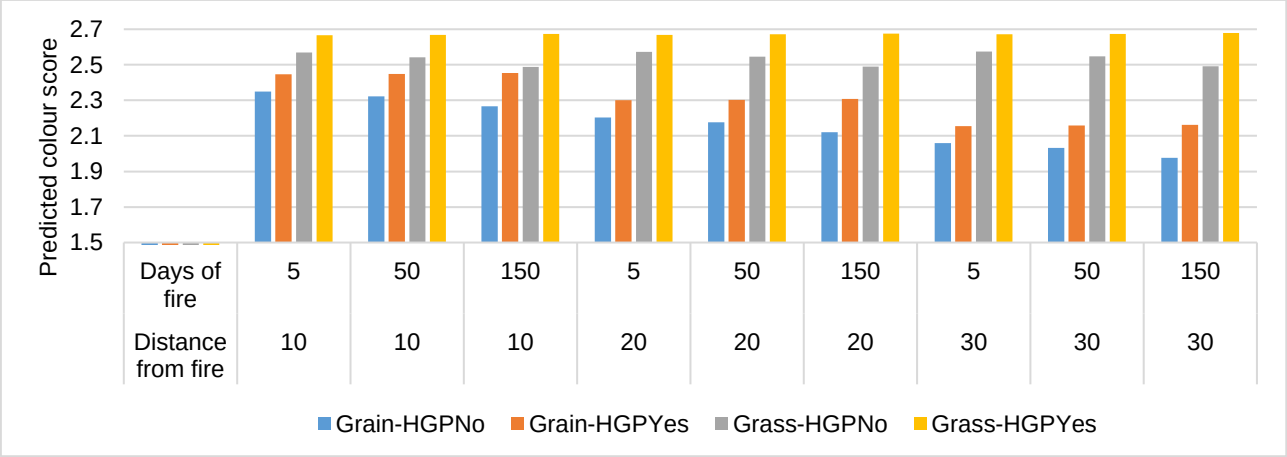

Figure 1. Effect of distance of property from fire (km), feed type (grain vs grass), days of fire (days) and use of hormonal growth promotants (HGP; no vs yes) on the predicted colour score. The following values were used for the calculations; sex = male, ossification = 184 hump height = 58.8 mm.

Grass fed animals were predicted to be darker in colour than grain fed as found previously [3] but as the fire came closer, the grain fed animals were more susceptible to dark colour possibly due to stress effects and glycogen depletion. To the best of our knowledge, negative HGP effects on colour have not been reported previously; the large sample size of this study has captured the small effect of HGP on colour. Given HGP treatment increases an animal's metabolic rate, we propose it makes the animal more susceptible to glycogen depletion when stressed and therefore prone to darker meat colour [4].

IV. CONCLUSION

This study has established that bushfire exposure is associated with darker coloured meat at grading; decreasing 'distance of property from fire' and increasing 'days of fire' negatively influenced colour outcomes. There is also evidence that production factors can interact with bushfire exposure and exacerbate the impacts on meat colour, with grass-fed animals and HGP treated animals more susceptible to darker meat colour outcomes when exposed to bushfire. These results will inform the development of remediation strategies for fire affected stock.

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