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The impact of two different hormonal growth promotants on post-mortem proteolysis of the *M. Longissimus lumborum* from feedlot finished steer carcasses (#425)

David Packer[1], Peter McGilchrist[1], John Thompson[1], Geert Geesink[1], Rod Polkinghorne[2, 1], Emily Hall[1]

[1] University Of New England, School of Environmental and Rural Science, Armidale, Australia; [2] Polkinghorne's Pty Ltd, Murrurundi, Australia

Introduction

Hormonal Growth Promotants (HGPs) are used to increase efficiency of beef production. The literature reports that cattle implanted with HGPs results in reduced eating quality and increased shear force (SF) (Watson 2008, Aust. J. Exp. Ag. **48**(11): 1425-1433). Packer et al. (2019, An. Prod. Sci. **59**: 384-394) compared two different HGP formulation effects on the eating quality of the *m. longissimus lumborum* (LL), aged for 5 and 35 days. They showed that different HGPs had different impacts on calpastatin activity, which presumably decreased protein degradation during post-mortem aging, resulting in decreased eating quality. Desmin is a key structural protein, which when degraded leads to increased tenderness (Taylor et al. 1995, J. An. Sci. **73**(5): 1351-1367). It is hypothesised the variation in eating quality due to HGP implants reported by Packer et al (2019) is associated with decreased proteolysis of desmin, which is the focus of this study.

Methods

A detailed description of the animals, sample preparation and laboratory procedures were provided by Packer et al. (2019). Briefly, as a sub-sample of the larger experiment, a total of 60 composite steers were randomly allocated to three HGP treatments comprising of control (CON), Oestradiol Only; (OES) or Trenbolone Acetate and Oestradiol (TBA+OES) and fed a finishing ration for 73 days. Two TBA+OES animals lost their HGP implant and were excluded. Right side striploins were collected at boning and prepared into five portions, and aged at either 3, 5, 10, 15, or 25 days at 4℃. Following aging, a sample for desmin analysis was collected, and a 65g block was cooked in a water bath at 70 ºC for 30 min and measured for SF (Perry et al. 2001, Aust. J. Exp. Ag. **41**(7): 953-957). Desmin degradation was determined using the technique by Geesink et al. (2006, J. An. Sci. **84**(10): 2832-2840), with minor modifications. Desmin degradation ratio (DDR) was calculated as (degradation product 1 + degradation product 2) / intact desmin. A higher DDR indicated greater desmin degradation. SF and DDR were analysed using mixed models (SAS 2002, V9) with fixed effects for HGP treatment (HGP), days aged (DA), DA*HGP, and striploin position, with a random term for animal nested within HGP. The DDR model also included SDS-PAGE gel number as a random effect.

Results

Hormonal Growth Promotant treatment, DA and striploin position all had significant effects on SF ($P<0.05$, Table 1), whereby TBA+OES had a significantly higher SF when compared to the CON for all aging periods ($P<0.05$, Table 2), apart from 5 and 25 days. There was no significant difference in SF between the CON and OES treatments at any of the aging periods ($P>0.05$, Table 2). Aging reduced SF in all treatments ($P<0.05$, Table 1, Table 2). The posterior LL portions had higher SF than the anterior LL portions ($P<0.05$, data not shown).

For the DDR there was a significant DA*HGP interaction ($P<0.05$, Table 1), whereby the TBA+OES was significantly lower than the CON treatment at each aging period ($P<0.05$, Table 3), apart from at 3 and 10 days. There was no significant difference in DDR between the CON or OES samples at any aging period ($P>0.05$, Table 3), apart from 25 days. Striploin position had no significant effect on DDR ($P>0.05$, Table 1).

Using the model for SF in Table 1, the inclusion of a covariate for DDR and a random effect for SDS-PAGE gel number resulted in a reduction in the F ratio for the HGP treatment. This reduction indicated that after adjusting for these terms in the model, DDR accounted for 39% of the HGP treatment effect for SF.

Conclusion

The TBA+OES treatment resulted in increased SF and decreased DDR. The DA*HGP interaction for DDR showed that the HGP effect varied with aging. For most aging periods there was no significant difference in SF or DDR between the CON and OES although there was a trend for the OES samples to have higher SF and lower DDR. The reduced DDR of the TBA+OES samples could be explained by the reduction in proteolysis caused by an increase in calpastatin activity when HGP implants are used (Packer et al. 2019).

Approximately 40% of the variation in the HGP treatment effect on SF was explained by differences in DDR. This agreed with literature in that part of the negative impact of HGP implants on eating quality is through decreased protein degradation and as a result, tougher beef.

The OES and CON treatments had a higher rate of desmin proteolysis than the TBA+OES samples up to 15 days aging, though slowed thereafter. Despite this, by 25 days there was little difference in SF between any of the HGP treatments. It could be that by 15 days the CON and OES treatments reached a maximum tenderness limited by perimysial intramuscular connective tissue (Purslow 2005, Meat. Sci. **70**(3):435-447), though because of a slower rate of proteolysis the TBA+OES treatment reached this point at a later time.

Notes

In conclusion, the decreased eating quality of LL in TBA+OES treated carcases, evidenced by increased SF values, was partly explained by the decreased proteolysis of key structural proteins such as desmin, which may be caused by an increase in calpastatin activity.

Trait	HGP Treatment			
Days Aged	CON	OES	TBA+OES	Stderr
3	0.65	0.62	0.52	0.070
5	0.53a	0.48ab	0.37b	0.070
10	0.69	0.74	0.63	0.070
15	1.16a	1.07a	0.76b	0.069
25	1.10a	0.92b	0.83b	0.070

Within rows, means with differing letters indicate a significant difference (P<0.05)

Table 3. Predicted means (and average standard errors)forDesmin Degradation Ratio (DDR) of the Control (CON), Oestradiol Only (OES) and Trenbolone Acetate and Oestradiol (TBA+OES) treatments.

Trait	HGP Treatment			
Days Aged	CON	OES	TBA+OES	Stderr
3	5.4a	6.0ab	6.4b	0.28
5	5.1ab	4.8a	5.7b	0.27
10	3.6a	3.8a	5.0b	0.27
15	3.4a	3.6ab	4.3b	0.27
25	3.2	3.4	3.5	0.27

Within rows, means with differing letters indicate a significant difference (P<0.05)

Table 2. Predicted means (and average standard errors) for shear force (kg) of the Control (CON), Oestradiol Only (OES) and Trenbolone Acetate and Oestradiol (TBA+OES) treatments.

Trait	SF (kg)		DDR	
	NND,DDF	F ratio	NND,DDF	F ratio
HGP Treatment (HGP)	2,55	5.35**	2,55	8.10***
Days Aged (DA)	4,213	64.62***	4,167	20.31***
DA * HGP	8,213	1.32	8,167	3.00**
Striploin Position	4,213	4.06**	4,167	2.17

*, P<0.05; **, P<0.01; ***, P<0.001

NDF, DDF – Numerator degrees of freedom, denominator degrees of freedom

Table 1. Significance (F ratios) for the effects of HGP treatment (HGP), days aged (DA), DA*HGP and striploin position on shear force (SF) and desmin degradation ratio (DDR). The SF model included a random term for animal nested within treatment, as did the DDR model, which also included a random effect for SDS-PAGE gel number.

Notes