



Serum markers of intramuscular fat deposition in beef cattle

Background

Marbling or intramuscular fat (fat between the muscles) is an important carcass trait that is said to enhance the eating quality of meat such as beef. This trait is highly desired by Asian consumers and as such, attracts premium prices by the Japanese market. Animals that are destined for these markets are traditionally finished in feedlots where they are fed for up to 360 days on grain based diets. Despite this expensive process of long term grain feeding, some cattle still don't meet the marbling specifications for these premium markets. It therefore would be beneficial to the industry if there was a marker that could be used to indicate the degree of marbling in the animal before slaughter. If this could be achieved, benefits would include savings in feed costs and a greater uniformity of product quality.

Potential link

Positive relationships between adipogenic (fat cell) activity in the blood serum and marbling performance in beef cattle have been reported. Serum prepared from blood collected from Wagyu beef cattle at the time of slaughter was included in a cell culture system to determine this relationship.

The results from this study indicate that the serum adipogenic activity may be used as a marker to identify cattle with a high degree of marbling. It is not known whether this serum adipogenic property is evident in beef cattle when they enter feedlot and if not, at what stage in the feedlot this property would appear. Therefore the aim of the present study was to evaluate serum adipogenic activity of beef cattle at the time of entry into the feedlot and at different stages in the feedlot.



marbled beef



wagyu beef cattle



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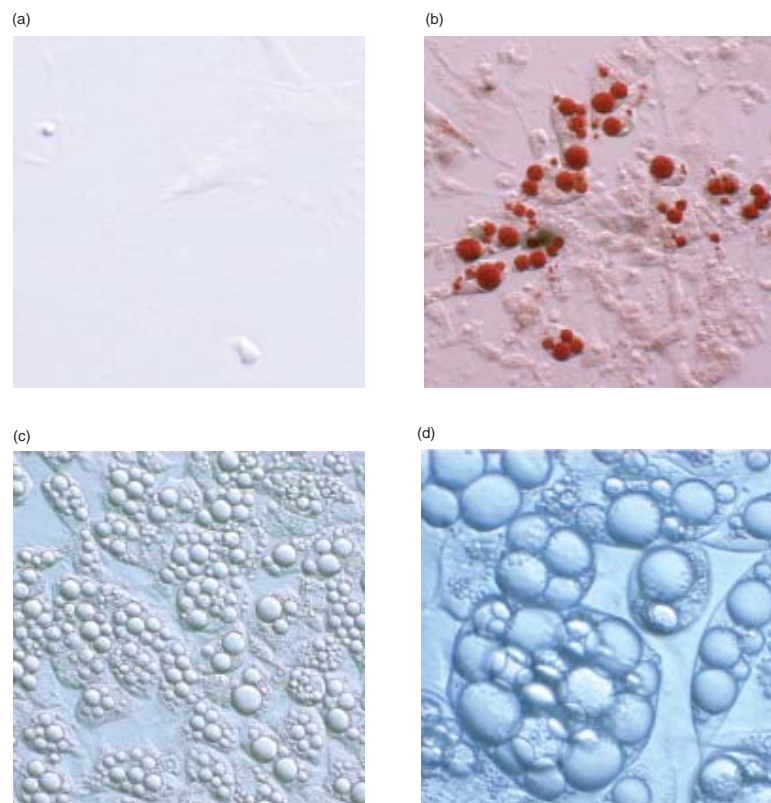
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Methods

Blood samples were collected from twenty Angus crossbred steers immediately before entering feedlot and at 150, 241 and at the time of slaughter (300 days). Ten of these twenty animals were supplemented with vitamin A. The degree of marbling was assessed according to AUSMEAT standards. Serum prepared from these blood samples was included in a 3T3 L1 cell culture system to measure adipogenic activity (fat cell development). Glycerol-3-phosphate dehydrogenase activity was used as a marker of adipogenic activity. As the results from this study showed no significant correlation between adipogenic activity and marbling performance, a separate study was conducted to re-evaluate the relationship between adipogenic activity of the serum at the time slaughter and marbling performance. In this second study blood samples were collected from 50 Angus crossbred steers at the time of slaughter (230 days in feedlot). Serum prepared from these blood samples were evaluated for their adipogenic activity in the 3T3 L1 cell culture system.



Murine 3T3-L1 preadipocytes grown using the cell culture system. (a) Fibroblastic like preadipocytes (x100), (b) 4 day differentiated adipocytes stained with Oil red O lipid stain, (c) 21 day differentiated adipocytes x200 and (d) 40 Day post-differentiated adipocytes x400

Results and discussion

Regression analyses showed that there was no correlation between adipogenic activity and marbling performance at 150, 241 or 300 days. Lack of a positive correlation between adipogenic activity at the time of slaughter and marbling performance is in disagreement with the results of Tori et al (1996). Tori et al (1996) used 19 beef cattle (12 Wagyu and 7 Wagyu x Holstein crosses) in their study and the degree of marbling ranged from 3 to 12 (Japanese marbling standards). In our study the degree of marbling varied from 2.1 to 5.2 (AUSMEAT marbling standards). The disagreement between our results and that Tori et al (1996) prompted us to conduct a separate study on the relationship between serum adipogenic activity at the time of slaughter and marbling performance using a larger number of animals. The results from this study also showed no significant correlation between serum adipogenic activity and marbling performance. The differences in the results between Tori et al (1996) and these studies may be due to breed and / or diet differences. In addition to measuring adipogenic activity, we also measured a number of serum metabolites and insulin to identify potential markers of marbling performance. Again, there was no significant relationship between any of these metabolites / insulin and marbling performance.

Conclusions

Discovery of a serum marker to identify marbling potential of beef cattle would be of immense benefit to the industry. Our results demonstrate that neither serum adipogenic activity nor serum metabolites / insulin are useful markers of marbling potential. It is possible that serum contains both adipogenic and anti-adipogenic factors and a lack of relationship between marbling and adipogenic effects of serum is due to opposing effects of these factors. It would be necessary to separate and purify individual serum markers to study their adipogenic effects separated from effects of other serum factors.



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