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NUTRITION FOR HIGH QUALITY BEEF PRODUCTION

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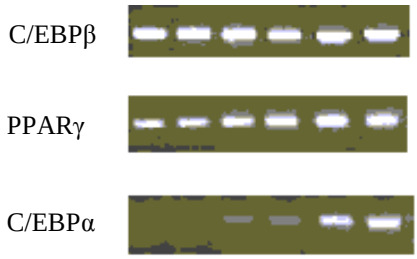
Beef marbling consists of a large amount of fat deposited in the skeletal muscle. High marbling is the distinct characteristic of beef in Japan and is preferred by Japanese consumers. Intramuscular adipogenesis is induced by feeding high-energy diets for long periods. Adipogenesis results from adipocyte differentiation. Therefore, intramuscular adipocyte differentiation significantly affects the formation of beef marbling. However, its regulating mechanisms have not been clarified. We are making studies on the mechanisms of intramuscular adipocyte differentiation and nutritional manipulation of adipocyte differentiation.

Bovine preadipocytes derived from adipose tissue

Preadipocyte cell lines sequentially express several transcription factors such as C/EBPs and PPARγ after induction of differentiation and these factors act cooperatively in this process. The adipose tissue–derived bovine preadipocytes, however, express C/EBPβ and PPARγ before induction of differentiation. The bovine preadipocytes reach more advanced stage of differentiation than preadipocyte cell lines.



Studies on mRNA expression of transcription factors by RT-PCR

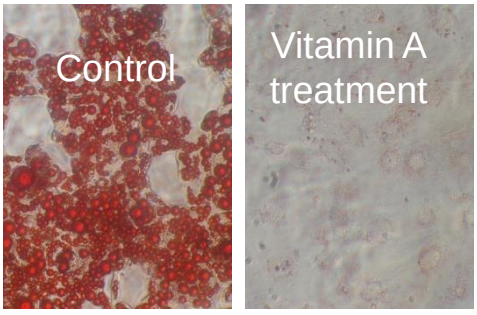
Bovine adipocyte differentiation and paracrine factors

The red color shows accumulated fat.
Myostatin suppressed adipocyte differentiation.

Members of the TGF-β family potently regulate cell growth and differentiation in a cell type-dependent manner. Myostatin and activin, members of the TGF-β family inhibited differentiation of preadipocytes, whereas BMP, another member of the TGF-β family, stimulated the differentiation. Currently, the mechanism on regulation of adipocyte differentiation by the TGF-β family is explored.

Nutritional manipulation of adipocyte differentiation

Japanese farmers give their beef cattle a vitamin A-deficient feed to improve beef marbling. This resulted in an increased incidence of blindness and muscular edema in the beef cattle. We found that vitamin A suppressed bovine adipocyte differentiation, and developed a new feeding strategy for improving beef marbling without the induction of vitamin A-deficient syndrome , i.e., feeding a low-vitamin A diet just during the early fattening period when the number of adipocytes increases in the muscle. Furthermore, we clarified that vitamin C and zinc stimulated bovine adipocyte differentiation. Now, we are trying to find other substances affecting adipocyte differentiation.



The red color shows fat droplets.
Vitamin A suppressed adipocyte differentiation.

Keywords

Beef cattle, Fattening, Beef marbling, Cell culture, Adipocyte differentiation, Vitamin, Mineral, Paracrine factor, Muscle, Animal nutrition, Molecular biology

Recent Publications

2012

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