



Influence of Metabolic Imprinting on Meat Quality: Impact of Feed Quality during Early Growth Period on Intramuscular Adipogenesis in Holstein

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Introduction

We would like to realize a good quality production system that by regulating the constitution of cattle and feeding domestic grass resources can produce safe beef in Japan. We investigated the effects of metabolic imprinting during the growth period on intramuscular adipogenesis that is related to meat quality by comparing between two groups of Holstein cattle; group R was fed only roughage until slaughter, while the other group C was fed concentrate from 2 to 10 mo of age and then fed only roughage until slaughter.

Conclusions

In longissimus muscles, there were significant differences of the mRNA expressions of PPARgamma2 related to adipocyte differentiation during growth, the intramuscular fat content, and the diameter of adipocyte at slaughter between these two groups. These results indicate that by regulating feed quality during the early growth period there is a possible metabolic imprinting effect on intramuscular adipogenesis. Study indicates that by regulating feed quality during the early growth period there would be a possible metabolic imprinting effect on intramuscular adipogenesis.

Materials and Methods

Sampling

Biopsy at 2, 5, 10, 17, and 22 months of age
From carcass at 26 months of age

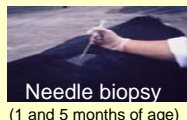
Analysis

1) RNA expression

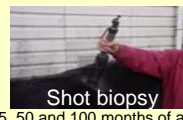
Semi-quantitative RT-PCR: PPAR gamma 2
internal control - ribosomal protein L7 (RPL7)

2) Histochemistry

Size of intramuscular adipocyte



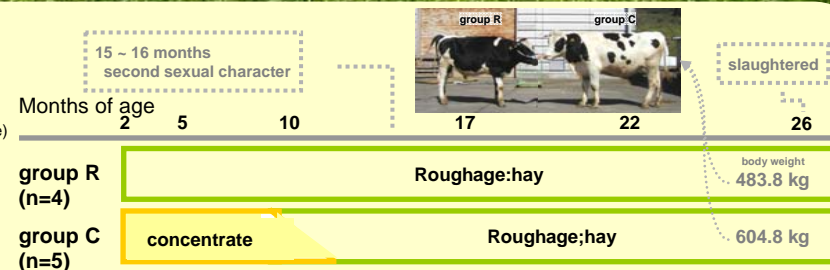
Needle biopsy
(1 and 5 months of age)

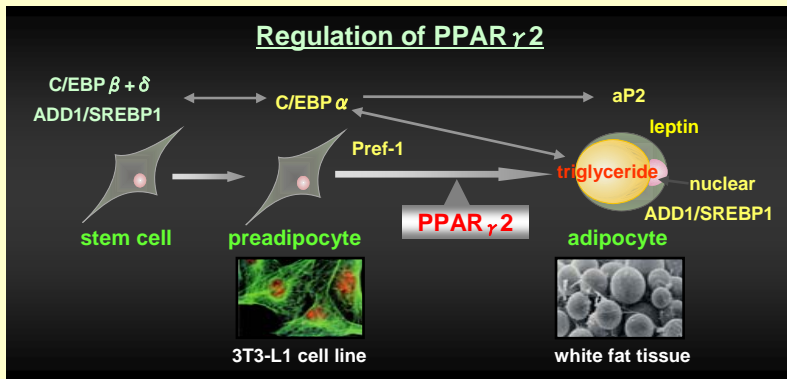


Shot biopsy
(15, 50 and 100 months of age)



longissimus muscle
(LM)





Results and discussion

The diameter of intramuscular adipose cells in LM was larger in group C than in group R at 10, 17 and 22 mo of age. Although the visual marbling scores of LM cross sections in carcasses were not significantly different between the two groups, the percentage of intramuscular adipose tissue content was about 3-fold higher in group C (3.4%) than in group R (1.3%) ($p < 0.001$). Ruminant meat is an important protein source for nutrition and intramuscular adipogenesis is closely related to meat quality. In this study, the expression of PPAR γ 2, an important factor in adipocyte differentiation, was influenced by the quality of feed during the early growth period. This was a useful result for analyses of the metabolic imprinting effect.

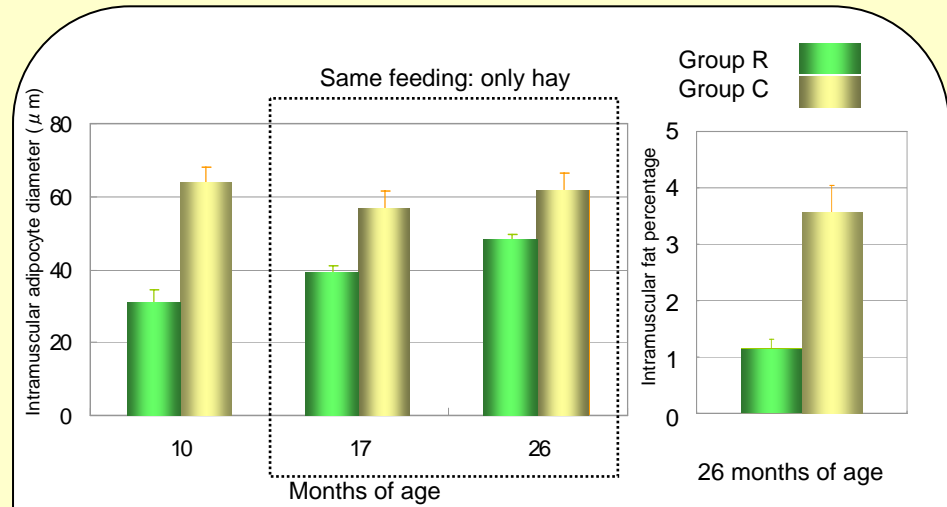


Figure. Intramuscular adipocyte diameter at 10, 17 and 26 months of age and intramuscular fat percentage at 26 months of age.

Table. Effects of different feed quality on carcass characteristics of Holstein steers slaughtered at 26 months of age

Item	group	
	concentrate	roughage
No. of animal	5	4
Slaughter weight, kg	604.8 ± 31.4	483.8 ± 46.3 **
Hot carcass weight, kg	271.8 ± 15.5	207.0 ± 26.8 **
Dressing percent	69.3 ± 0.6	70.1 ± 0.2 *
Subcutaneous fat thickness, cm	0.2 ± 0.1	0.1 ± 0.0
Longissimus muscle area, cm ²	24.4 ± 3.4	25.3 ± 2.2
Rib thickness, cm	3.4 ± 0.8	3.1 ± 0.3
Marbling score	1.0 ± 0.0	1.0 ± 0.0
Grade	1.2 ± 0.4	1.0 ± 0.0
Longissimus muscle fat composition, %	3.4 ± 1.3	1.3 ± 0.1 *

Values are means ± SD. concentrate = Steers fed ad libitum concentrate from 2 to 10 mo, then fed ad libitum roughage until slaughter; roughage = Steers fed ad libitum roughage until slaughter. * means significantly differences between groups ($P < 0.05$). ** means significantly differences between groups ($P < 0.01$).

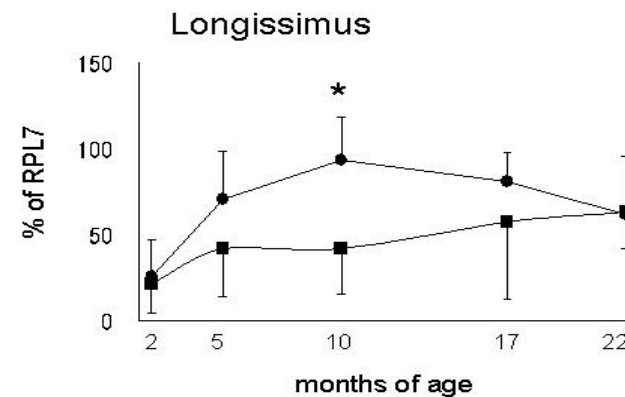


Figure. Effect of different feed quality on PPAR γ 2 mRNA expressions in longissimus muscle of Holstein steers.

●; concentrate group = Steers fed ad libitum concentrate from 2 to 10 mo, then fed ad libitum roughage until slaughter; ■; roughage group = Steers fed ad libitum roughage until slaughter. * means are significantly different between groups at $P < 0.05$