2-P14

A METHOD FOR ESTIMATION OF FATTENING STAGE OF BEEF CATTLE USING MOLECULAR SPECIES COMPOSITIONS OF TRIACYLGLYCEROLS IN SUBCUTANEOUS FAT BIOPSIES

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Keywords : fattening, subcutaneous fat, triacylglycerol, biopsy

Background :

In Japan, beef with fat marbling is preferred to it without marbling for "Sukiyaki" being a traditional Japanese beef cooking. Management methods of Japanese Black cattle for production of marbling beef are generally the body weight measurement and the judgment based on the observation of appearance of individual cattle during fattening period. In rare case, ultrasonography is used for judgment of marbling grade of *M. longissimus* during fattening. The development of a new method instead of expensive ultrasonograph is anticipated.

Objectives :

The objective of this study was to investigate the application of molecular species composition of triacylglycerol in subcutaneous fat biopsies taken from fattening cattle as a new method for estimation of fattening stage and of right or wrong of fattening process.

Methods:

Subcutaneous fat biopsies for the determination of fatty acid and molecular species compositions during fattening period of Japanese Black steers were taken from the site of about 1cm under skin of near tube ishadicum of the left side of tail head. Japanese Black cattle collected subcutaneous fat samples were 17 heads at 11 months of age, 12 heads at 19 months of age and 12 heads of 26 months of age. Finishing age of fattening Japanese Black was 32 months of age. These cattle were fed *ad libitum* a high energy ration consisting of milo, corn, barley, wheat bran and others. The ratios of milo, corn and barley in ration for fattening animals at 19 and 26 months of age were larger than that of 11 months of age. The rations has >68% and 70% of total digestible nutrient, and 11.5% and 9.0% of total crude protein for animals at 10 to 14 months and after 14 months of age, respectively. Subcutaneous fat biopsy samples were immediately put into cool chloroform in small test tube and crushed by glass rod. After filtration, the chloroform layer including neutral lipid of subcutaneous fat was concentrated under reduced pressure on rotary evaporator and stored in vials under nitrogen at -20C.

Fatty acid compositions and molecular species compositions of triacylglycerol in subcutaneous fat biopsies were analyzed by gas chromatography using DB-WAX (0.25mm x 30m ; J&W) column for fatty acid and UA$^+$-65 (0.25mm x 15m ; Frontier Lab, Kooriyama-shi, Japan) column for triacylglycerol with raising method of the temperature continuously.

Results and Discussions :

The concentrations of myristoleic (C14:1), palmitoleic (C16:1) and oleic (C18:1) acids increased in fattening period, on the other hand, myristic (C14:0), palmitic (C16:0) and stearic (C18:0) acids' concentrations decreased.

There were over 30 peaks on a chromatogram for molecular species analysis of a subcutaneous fat biopsies. Compositions of the chief molecular species of triacylglycerols of subcutaneous fat biopsies are shown in Fig. 1.

The major molecular species of triacylglycerols in fat biopsies were palmitoyl (P) - dioleoyl (OO) - glycerol (POO), PPO, [P - palmitoleoyl (Po) - O - glycerol[PPoO]], P - stearoyl (S) - O - glycerol (PSO), P - O - linoleoyl (L) - glycerol (POL). POO had the highest level in these molecular species of triacylglycerol. In depot fat of beef [1,2] and pork [3], POO had also the highest concentration in molecular species of triacylglycerol. Therefore, a lot of POO may be synthesized in depot fat tissue regardless of animal species or composition of ration. PoPoPo, [PPoO] and POL concentrations increased, [PPPo], PPO, PSO and SOO concentrations decreased during fattening period.

Relations between fattening period and each molecular species concentration of triacylglycerol were analyzed. There was the best relation between POL and PPO concentrations for fattening period of Japanese Black (Fig. 2). The areas of POL-PPO plotting were put together for each fattening period. The area of 26 months of age was smaller than that of 19 or 11 months of age. The area will converge to a small area at final stage of fattening. If a POL-PPO value is not in this area, the animal being taken fat biopsy from may have some obstacles on fattening. This method determining molecular species composition of triacylglycerol in subcutaneous fat biopsy taken from fattening beef cattle is very effective for fattening management of beef cattle fattened by the same fattening condition during fattening.

Conclusions :

Subcutaneous fat biopsies could be taken easily from fattening cattle without any struggles. The chloroform solution of fat biopsies could be injected directly without preconditionings to gas chromatograph for the analysis of molecular species compositions. The values of POL and PPO converged to a small area with passing months of fattening. The determination of molecular species composition of triacylglycerol in subcutaneous fat biopsy taken from fattening beef cattle is a good method for estimation of fattening stage and management of fattening of beef cattle.

Pertinent literature:

1) Itoh M., Arihara K. and Kondo Y., Molecular species compositions of intramuscular triacylglycerols of beef. Animal Sci., Technol. 68(8), 765-759, 1997

2) Itoh M. and Arihara K. Molecular species compositions of triacylglycerols in subcutaneous fat biopsies taken from fattening Japanese Black. Animal Sci., Technol., 69(10), 933-936, 1998

3) Itoh M. and Arihara K. Molecular species compositions of intramuscular triacylglycerols of porcine muscles. Animal Sci., Technol. 69(10), 937-940, 1998

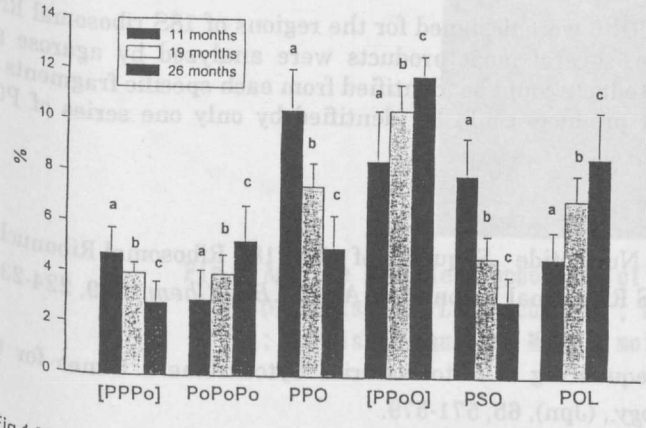

Fig.1 Molecular species compositions of triacylglycerols in subcutaneous fat biopsies at 11, 19 and 26 months of age of fattening Japanese Black.

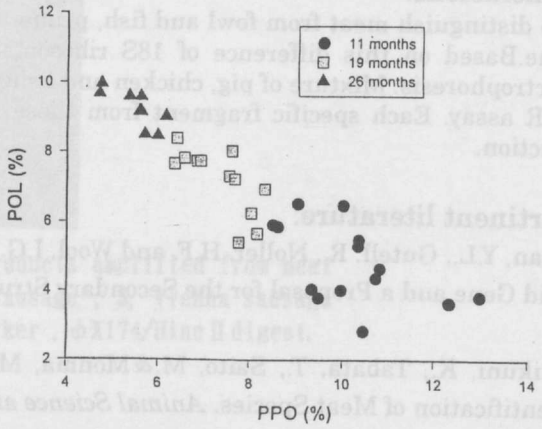

Fig.2 Relations between PPO and POL in triacylglycerols of subcutaneous fat biopsies at 11, 19 and 26 months of age of fattening Japanese Black.