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IS THERE ANY DIFFERENCE IN TRIGLYCERIDE SPECIES AND FATTY ACID COMPOSITION OF SERUM AND HEPATIC LIPIDS BETWEEN RATS RAISED WITH DIETS CONTAINING BEEF TALLOW AND THOSE WITH VEGETABLE OILS?

TATSUMI ITO, SATOSHI KAWAHARA, KAORI INOUE AND SHINYA HIRAI

Laboratory of Chemistry and Technology of Animal Products, Faculty of Agriculture, Kyushu University 46-06, 6-10-1 Hakozaki, * Higashiku, Fukuoka 812, Japan

INTRODUCTION

Excess intake of animal fats induces hyper-lipidemia and cholesteraemia, which result in coronary heart disease and cancer, etc.(1-4). Also, the number of obesity and the number of patients of fatty liver have still increased(5-7). Therefore, it has been recommended to reduce the intake of fat from daily diets and also recommended to substitute animal fats rich in saturated fatty acids with vegetable oils rich in unsaturated fatty acids. On the other hand, the palatability of beef is increased with increasing marbling score, and beef patties containing a certain level of palmitic acid got a high score in panel tests(8). Therefore, it is important to specify a relation between a desirable fat content of beef for palatability and upper limit of safety intake of animal fats. With regards to this subject, we have examined the effects of dietary lipids (beef tallow, soybean oil, palm oil, palm super-olein and palm mid-fraction) on the level of serum triglycerides and on the accumulation of lipids in the liver, and have shown that (1) the concentration of serum triglycerides and cholesterol of rats raised with solid fats(beef tallow, palm oil and palm mid-fraction) were significantly higher than those of rats raised with soybean oil, (2) the accumulation of lipids in the liver of rats raised with beef tallow was appreciably less than that with soybean oil, and (3) fatty acid composition of lipids accumulated in the liver was greatly influenced by the composition of dietary lipids, while the composition of serum lipids was not significantly influenced by dietary lipids(9).

The objectives of the present study were to investigate a relation between triglyceride species of dietary lipids and those of lipids accumulated in the liver, and also to investigate the effect of dietary lipids on enzymatic activities of peroxysomal ß-oxidation and acetyl-CoA carboxylase, both of which are involved in lipid metabolism in the liver.

MATERIALS AND METHODS

Animals and diets

SD rats(male, 7 weeks old) were raised with diets containing 20% of beef powder,12% of lipids, saccharose(sucrose, cellulose and corn starch), DL-methionine, sodium bitartrate, vitamins, minerals and cholesterol for 4 weeks in cages separately in a Biotron (20 °C

Abbreviations: LOO, linoleoyl-dioleoyl-glycerol; OOO, trioleoyl-glycerol; OAP, oleoyl-arachidonoyl-palmitoyl-glycerol; SOO, stearoyl-dioleoyl-glycerol; POO, palmitoyl-dioleoyl-glycerol.

in temperature, 60% in humidity, 12 hr in lightening). Dietary lipids used in the present study were beef tallow, olive oil, canola oil and safflower oil.

Triglycerides, cholesterol, GOT,GPT and choline-esterase activity in the serum

These biochemical parameters were examined with diagnostic kits(Wako Chemicals, Inc.).

Serum and hepatic lipids

Lipids were extracted from 0.5ml of serum and 0.6g of liver with 5vol of chloroform-methanol mixture according to the method of Folch(10). Extracts were evacuated under the flow of N2 gas, followed by freeze-drying.

Gas chromatography

After the hydrolysis of lipids in 5% methaol-HCl mixture, fatty acid composition of dietary lipids and serum and hepatic lipids was analyzed with gas chromatograph GC-14A(Shimadzu) equipped with HR-SS-10(25 x30cm) column(Ulbon) under the conditions of column temperature:150-220 C(4 C/min). Detection was made with FID.

Triglyceride composition

Serum and hepatic lipids were subjected to silica gel column (25 x550mm) chromatography to separate triglycerides from phospholipids and glycolipids, etc. Separation of triglyceride species was made on HPLC SCL-10A LC column[LC-ODS (H) 25CM] (Shimadzu). Glyceryl tripalmitate, glyceryl trioleate, glyceryl trilinolate, glyceryl-1,2-elaidate-3-linoelaidate and glyceryl-1,2-oleate-3-palmitate were used as standard triglycerides.

Peroxysomal ß-oxydation and acetyl-CoA carboxylase

Crude enzymes were prepared from rat liver by the method of Takada et al.(11). ß-oxydation activity and acetyl-CoA carboxylase activity were measured according to the method of Lazarow and de Dube(12) and that of Nakanishi and Numa(13), respectively.

RESULTS AND DISCUSSION

Table 1 represents the amount of lipids accumulated in the liver and some biochemical parameters in the serum. The amounts of lipids in the liver of rats raised with beef tallow were not so large when compared to other groups of rats raised with vegetable oils. Triglyceride level in the serum of rats raised with olive oil was higher than those of rats raised with other lipids. Serum cholesterol levels of rats raised with olive oil and beef tallow were appreciably higher than those of rats raised with other vegatable oils. GOT level of rats raised with beef tallow was significantly lower than those of rats raised with vegetable oils examined. GPT level of rats raised with beef tallow and the levels of rats fed with canola oil and olive oil were significantly lower than that of rats fed with safflower oil. These results indicate that the intake of an appropriate amount of beef tallow isn't harmful for the function of the liver of rats. As described in a previous paper (9), fatty acid composition of hepatic lipids was similar to that of dietary lipids, but no similarity was observed between dietary and serum lipids when rats were raised with beef tallow, olive oil and canola oil. However, when rats were fed with safflower oil, the situation was reverse (Data not shown). Fig. 1 shows triglyceride species of dietary lipids, serum lipids and hepatic lipids. In summerizing the results of this figure, (1)serum and hepatic lipids contained large amount of OAP, and (2)regardless of triglycerides composition of diets and of serum lipids, lipids accumulated in the liver contained a certain amount of SOO and POO

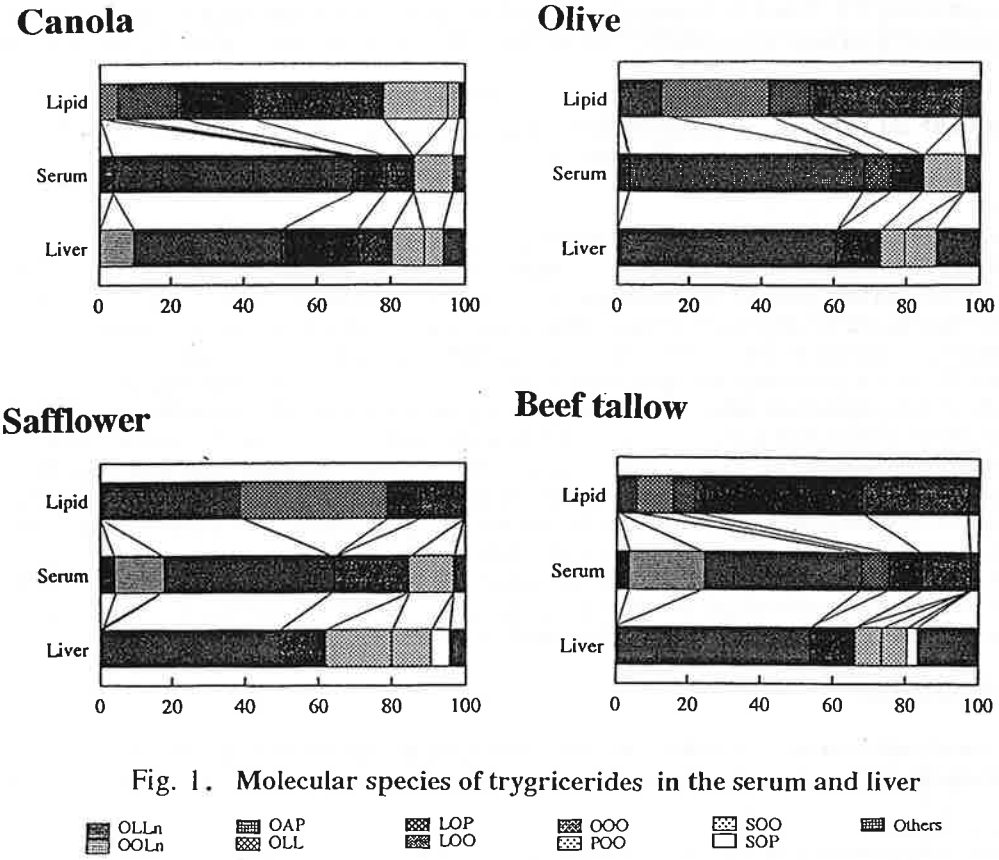

Fig. 1. Molecular species of trygricerides in the serum and liver

whose melting points are relatively high, while serum lipids contained a certain amount of LOO and OOO whose melting points are relatively low. Specific activities of acetyl-CoA carboxylase, rate-limitting enzyme of fatty acids synthesis, and peroxysomal ß-oxidation enzymes, rate limitting enzymes of fatty acids decomposition,of the liver of rats raised with beef tallow showed intermediate values when compared to those of rats raised with vegatable oils (Data not shown).

CONCLUDING RAMARKS

Some biochemical parameters of the serum, which indicate diagnostic of the liver, showed intermediate values when rats were raised with beef tallow. Specific activities of acetyl-CoA carboxylase and peroxysomal ß-oxidation enzymes of the livers of rats raised with beef tallow also showed intermediate values when compared to those of rats raised with vegetable oils. Fatty acid composition of lipids accumulated in the liver of rats raised with beef tallow was similar to that of dietary beef tallow. Situation was quite similar for rats fed with olive and canola oils. However, the composition of fatty acids in the liver of rats fed with safflower oil was quite different from that of dietary oils. Triglycerides species of lipids accumulated in the liver differed from those of dietary lipids and also differed from those of serum lipids. These results indicate that steric recombination of constituent fatty acids occurs when triglycerides are resynthesized in the liver.

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Table1. Some biochemical parameters in serum and the amount of lipids accumulated in the liver of rats.

Parameter	Diet			
	Beef tallow	Olive oil	Canola oil	Safflower oil
Hepatic Lipids (mg/ g tissue)	134.9 ± 17.5	149.9 ± 37.7	90.7 ± 13.9	120.2 ± 21.3
Serum triglycerides (mg/dl)	196.6 ± 31.6	297.8 ± 37.9	195.6 ± 24.8	187.5 ± 47.9
Serum cholesterol (mg/dl)	101.2 ± 14.3	105.4 ± 11.7	66.4 ± 10.8	70.8 ± 10.1
GOT (IU/l)	88.1 ± 5.2	103.5 ± 1.1	108.3 ± 3.9	108.4 ± 5.8
GPT (IU/l)	29.8 ± 7.5	21.8 ± 2.8	26.0 ± 3.8	55.8 ± 3.8