TRANSLATION FORM OF DEPOT FAT IN STARVATION

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INTRODUCTION

Gordon *et al*¹⁻³ suggested that the transport of depot fat to the site of utilization probably takes place in the form of free fatty acid (unesterified fatty acid).

Under both normal and abnormal circumstances, the amount of free fatty acid is very small in the serum and liver occupying only 1/4~1/5 of triglyceride or phospholipid. The portion derived from dietary fat is transported mainly in the lymph and then in the blood in the form of triglyceride (chylomicron) to be deposited as it is.

We have therefore used fasting albino rats to measure triglyceride and free fatty acid in the serum and liver, suggesting thereby the transport of depot fatty acid in the form of triglyceride instead of free fatty acid.⁴

Further experiments have revealed the occurrence of transportation in the form of a low density lipoprotein, as reported below.

EXPERIMENT

Male albino rats of approximately 200 mg were maintained on the following basic diet for 3 weeks and fasted for 48 hours, receiving water alone. One sample consisted of materials obtained from 15 rats and 3 samples made up 1 group. Each lipoprotein in the serum was separated by an ultracentrifugal method⁵ and each fat in the lipoprotein was isolated by the method of the author.⁶ After adding an adequate amount of NaCl and NaBr to serum, a low density lipoprotein with $d < 1.019$ was separated at 40,000 rpm for 22 hours, a low density lipoprotein with $d = 1.019 - 1.063$ was centrifuged at 40,000 $\times$ g

for 22 hours, and a high density lipoprotein with $d = 1.063 - 1.21$ and $d > 1.21$ at $40,000 \times g$ for 48 hours. Each lipoprotein was further subjected to mild extraction with methanol : ether (3:1), followed by chromatography on silicic acid and then alumina, to separate the fractions of cholesterol ester, triglyceride, diglyceride, monoglyceride, free fatty acid, free cholesterol and phospholipid. Fatty acids in triglyceride and depot fat were analyzed by gas chromatography.⁷

Basic Diet

Casein*	14 g	α . Tocopherol	2 mg
Starch	36 g	B ₁₂	0.002 mg
Sucrose	36 g	Niacin	20 mg
M. Salt	4 g	Thiamin-HCl	2 mg
Olive oil	10 g	B ₂	3 mg
A	3,000 I.U.	Pyridoxine	3 mg
D ₃	400 I.U.	Pantothenic acid	1 mg
Ascorbic acid	75 mg	K	0.4 mg
Choline HCl	100 mg		

(* washing with mild methanol and ether)

RESULTS AND DISCUSSION

The serum total fat in adult albino rats reached a maximum within 2~3 days after fasting.⁴ The determination was therefore carried out within 48 hours of fasting. Table 1 summarizes the amount of each fat in serum lipoprotein in albino rats maintained on a constant basic diet for 3 weeks and fasted for 48 hours in comparison with controls before fasting (normal).

At 48 hours of fasting, as compared with the pre-fasting state, triglyceride in the low density lipoprotein with $d < 1.019$ increased by about 1.6 times, occupying about 54% of this lipoprotein. The increase in other fractions was minimal. Table 2 summarizes the results of comparison between the amount of each fatty acid in the triglyceride in low density lipoprotein with $d < 1.019$ and that in depot fat before fasting.

In both groups, C₁₈:1 was found to be the most abundant followed by C₁₆:0, while the amount of C₁₄:0, C₁₂:0, C₁₀:0, C₁₈:2, C₁₈:3, and C₂₀:4 was small, giving a rather similar fatty acid composition.

These results appeared to indicate that the triglyceride in the low density lipoprotein ($d < 1.019$) which increased in the serum upon fasting was probably derived from depot fat.

Table 1
Changes in each fat in serum lipoprotein in albino rats 48 hours after fasting

Condition	Serum lipoprotein	Each fat in lipoprotein (each average mg per serum 100 ml)						
		Cholesterol ester	Triglyceride	Diglyceride	Monoglyceride	Free fatty acid	Free cholesterol	Phospholipid
Hunger (after 48 hours)	Low density lipoprotein	d* <1.019	76.4	—	—	5.4	8.7	27.5
		d=1.019 ~1.063	9.3	—	—	3.3	12.0	15.6
	High density lipoprotein	d=1.063 ~1.21	7.8	—	—	4.8	6.2	6.6
		d >1.21	8.1	—	—	12.6	6.3	30.3
Normal	Low density lipoprotein	d <1.019	47.1	0.3	0.6	3.6	6.0	26.7
		d=1.019 ~1.063	7.4	—	—	3.0	12.3	13.8
	High density lipoprotein	d=1.063 ~1.21	8.1	—	—	3.2	7.2	6.1
		d >1.21	6.0	—	—	9.9	10.8	25.5

* d = specific gravity.

Table 2
Fatty acid composition in the triglyceride in low density lipoprotein ($d < 1.019$) in serum of albino rat after 48 hours of fasting and the fatty acid composition of depot fat before fasting (normal).

Kinds	Fatty acid composition (%)										
	C ₁₀ :0	C ₁₂ :0	C ₁₄ :0	C ₁₆ :0	C ₁₈ :0	C ₂₀ :0	C ₁₄ :1	C ₁₆ :1	C ₁₈ :1	C ₁₈ :2	C ₂₀ :4
Triglyceride of serum low density lipoprotein ($d < 1.019$) in hunger	0.6	1.0	2.1	15.8	3.4	0.2	—	3.2	68.1	5.6	—
Depot fat in normal	0.3	0.8	1.2	20.1	7.0	—	—	4.4	58.5	7.7	—

The transport of depot fat upon fasting thus appears to take place not in the form of free fatty acid but in the form a low density lipoprotein mainly triglyceride.

SUMMARY

Albino rats were maintained on a constant basic diet and fasted for 48 hours, to determine each lipid in serum lipoprotein for comparison with the value before fasting.

As the result, triglyceride in low density lipoprotein appeared to have increased as compared with the prefasting level. Other fats increased only slightly. The fatty acid composition of the increased triglyceride was relatively quite similar to that of depot fat before fasting.

The depot fat thus appeared to be transported during fasting, not in the form of free fatty acid but in the form of a low density lipoprotein, mainly triglyceride.

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