Effects of Excess Doses of α -Tocopherol on Lipid in Serum and Muscle of Rainbow Trout

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Rainbow trout *Oncorhynchus mykiss* were fed on diets containing two different α -tocopherol levels (10 mg and 1,000 mg/100 g diet) to investigate the excess doses of α -tocopherol on serum and muscle lipid. The excess doses of α -tocopherol (1,000 mg) induced lower serum lipid levels for 40 days, and also lower muscle lipid levels for six months compared to the normal α -tocopherol doses. These results indicate that 1,000 mg- α -tocopherol doses can be a factor affecting the lipid distribution in this fish.

The effects of dietary α -tocopherol on serum lipid content have been studied in some mammals. It has been reported that α -tocopherol doses prevent the increase of serum cholesterol, and in the other cases, clearly decrease it in some experiments.^{1–4)} Conversely, it has been reported that α -tocopherol induced an increase of serum cholesterol in other studies.^{5–8)} But we do not have details of the α -tocopherol effects on the serum lipid in fish. Thus, we in-

vestigated the changes in lipid levels in serum as well as in muscle by excess doses of α -tocopherol in rainbow trout.

Table 1 shows the composition of the test diet. The control diet has 10 mg of α -tocopherol per 100 g of diet which is recognized as one of the adequate levels for rainbow trout^{9,10)} and the experimental diet has 1,000 mg per 100 g of diet. Twenty fish averaging 12.5 g were fed diets in each group. Serum lipid and α -tocopherol levels of ten fish at the 40th day and muscle lipid content and composition of the other ten fish at the sixth month were analyzed.

The lipid was extracted from serum and muscle by the Bligh and Dyer's method,¹¹⁾ applied to a thin-layer plate (Silica Gel 60) and developed by solvent (n-hexane:ether:acetate = 80:30:1 v/v/v). Then the lipid content and composition were determined as shown in the previous paper.¹²⁾ Determination of α -tocopherol in serum also followed the previous report.¹²⁾

Table 2 shows the serum lipid and α -tocopherol content. The lipid level (mg/100 ml serum) in the experimental group was 842, which was clearly lower than 1232 determined in the control group, whereas the α -tocopherol level in the experimental group (91.6) was over ten times that of the control group. Table 3 indicates the muscle lipid content per wet tissue weight and the composition. No difference, however, was seen in the lipid composition between

Table 1. The Composition of the diet (g/100 g diet)

	Control	Experiment
α -Tocopherol (mg)	10	1,000
Casein	45.0	
Dextrin	20.0	
α -Starch	15.0	
Cod-liver oil* ¹	6.0	
Lard* ¹	4.0	
Mineral mixture* ²	4.0	
Vitamin mixture* ³	1.0	
Choline-Cl	0.5	
Cellulose	4.49	3.5

*¹: Residual tocopherol was 41 μ g in Cod liver oil and 9 μ g in Lard.*²: McCollum's Salt No. 185.*³: Vitamin mixture free from tocopherol.**Table 2.** Lipid and α -tocopherol levels in serum at the 40th day of feeding period (mg/100 ml serum)

	Control (10 mg)	Experiment (1,000 mg)
Lipid	1232 $\pm$ 82	842 $\pm$ 116
α -Tocopherol	7.7 $\pm$ 12	91.6 $\pm$ 13.0

Mean $\pm$ s.d. (n = 10)**Table 3.** Muscle lipid content and composition at the 6th month of feeding period

Group	Lipid content (%)	Composition (%)					
		PL	MG+DG	Chol.	FFA	TG	SE+HC
Control (10 mg)	7.20 $\pm$ 0.54	20.6 $\pm$ 4.0	4.2 $\pm$ 1.4	8.2 $\pm$ 1.1	5.3 $\pm$ 2.0	58.5 $\pm$ 3.7	3.2 $\pm$ 0.4
Exp. (1,000 mg)	5.98 $\pm$ 0.42*	25.0 $\pm$ 5.4	3.5 $\pm$ 0.5	8.9 $\pm$ 1.3	6.3 $\pm$ 1.7	54.0 $\pm$ 5.8	2.3 $\pm$ 0.8

PL; polar lipids, MG; monoglyceride, DG; diglyceride, Chol.; cholesterol, FFA; free fatty acid, TG; triglyceride, SE; sterol ester, HC; hydrocarbon.

* Significantly different from control. (n = 10, p < 0.05)

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two groups, the lipid content in the experimental group was significantly lower than the control.

We have already reported that excess doses of α -tocopherol raise the liver lipid content.¹²⁾ In the present study, however, it has been shown that the decrease in lipid content in serum and also in muscle are induced by the excess doses of α -tocopherol. It is considered that these phenomena of lipid distribution and its metabolisms are not induced by only the antioxidative action of α -tocopherol but also by other roles, especially in the case of constant excess doses.

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