relative biological effectiveness at near-tolerance levels in CF No. 1 female mice is 7 (plutonium 239):3, (polonium 210):2, (uranium 232):1 uranium 233):1 (radium 226).

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Absorption of Cholesterol-4-C^{14} in Rats Fed Mixed Soybean Sterols and β-Sitosterol.* (20395)

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The hypercholesteremia and atherosclerosis observed in the cholesterol-fed chicken can be prevented by the addition of soybean sterols to the diet. To explain this phenomenon the suggestion has been made that the plant sterols interfere with the absorption of cholesterol(1,2). In the experiments presented here we have tested this hypothesis by feeding rats C^{14}-labeled cholesterol together with either β-sitosterol or soybean sterols and determining the recovery of the C^{14} in thoracic duct lymph.

Experimental. Rats of the Long-Evans strain weighing 250-300 g were used. They were maintained on a stock diet with the following composition: ground whole wheat, 64.3%; casein, 14.3%; skim milk powder, 6.8%; NaCl, 0.7%; $CaCO_3$, 1.4%; Wesson Oil, 11.5%; fish oil, 1%; and a trace of KI. Forty-eight hours before the experiment all food was removed from the cages, but for the 24 hours just preceding the operation the animals again had access to the stock diet. This feeding procedure ensured the presence of food in the intestinal tract, and consequently a copious lymph flow, at the time the cannulae were inserted into the thoracic ducts. The procedure used for collection of thoracic duct lymph has been described elsewhere(3). Rats with poor lymph flow were discarded at the time of operation. Immediately after the cannulation a test meal containing labeled cholesterol (Table I) was administered by stomach tube. During the rest of the experiment the rats had access to the stock diet and 0.9% saline for drinking purposes. The synthesis of cholesterol-4-C^{14} used in this study was described earlier(4). *Total C^{14} content of lymph* samples was determined as described elsewhere(5). Free and total cholesterol was determined by the procedure of Sperry and Webb(6). The C^{14} content of the cholesterol digitonide was determined by dissolving it in methanol and a suitable aliquot mounted on an aluminum plate for counting.

Results and discussion. The effects of mixed soy sterols and of β-sitosterol upon the recoveries of C^{14} in thoracic duct lymph were studied. The design of the 2 experiments is shown in Table I. It is clearly shown there that the simultaneous administration of C^{14}-cholesterol with either mixed soy sterols on

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TABLE I. Recovery of Enterally Administered Labeled Cholesterol in Lymph of 20 Rats.

Exp.	Test meal	% administered C^{14} recovered in thoracic duct lymph in 48 hr	% lymph's C^{14}-cholesterol in esterified form
1	0.25 cc cottonseed oil followed by 4 mg C^{14}-cholesterol in 0.25 cc cottonseed oil	26	63
		21	39
		30	47
		18	41
		25	58
		30	50
		32	42
	4 mg mixed soy sterols* in 0.25 cc cottonseed oil followed by (‡)	6	39
		8	34
	25 mg mixed soy sterols* in 0.25 cc cottonseed oil followed by (‡)	0.6	
		5	11
2	0.25 cc cottonseed oil followed by (‡)	33	42
		37	59
		43	51
		34	47
	4 g β-sitosterol† in 0.25 cc cottonseed oil followed by (‡)	8	22
		7	25
	25 mg β-sitosterol† in 0.25 cc cottonseed oil followed by (‡)	1	20
		5	23
		1	41

* Reported to contain 95% sterols, 10-15% of which were stigmasterol and 75-80% sitosterols. We are indebted to Distillation Products Industries for the mixed soy sterols.

† We are indebted to Lederle Laboratories for the β-sitosterol.

‡ 4 mg C^{14}-cholesterol in 0.25 cc cottonseed oil.

β-sitosterol resulted in a pronounced decrease in the C^{14} recoveries in lymph. These results show that plant sterols interfere with cholesterol absorption in the rat. Tomkins, in this laboratory(7), has shown that hepatic cholesterogenesis from acetate in the rat is not influenced by feeding it a diet containing 2.5% mixed soy sterols and 5% cottonseed oil for 6 days. It therefore seems likely that plant sterols prevent hypercholesterolemia in birds fed cholesterol by interfering with the absorption of the cholesterol.

The data recorded in the last columns of Table I show the percentages of the labeled lymph cholesterol that were in esterified form. It would appear that the administration of the mixed soy sterol or of β-sitosterol decreased the percentages of the C^{14}-cholesterol in the esterified form. This decrease suggests that the plant sterols may act by interfering with esterification of cholesterol in its passage from the lumen of the intestine to lymph.

Summary. 1. The effect of plant sterols on cholesterol absorption was studied. Ring-labeled cholesterol was fed by stomach tube to rats into whose thoracic ducts cannulae had been inserted. 2. Simultaneous feeding of mixed soy sterols or of β-sitosterol with labeled cholesterol resulted in a pronounced reduction in the C^{14} recoveries in thoracic duct lymph. 3. Approximately 50% of C^{14}-cholesterol in lymph was esterified when the test meal contained only labeled cholesterol and cottonseed oil. Less of lymph's C^{14}-cholesterol was esterified when mixed soy sterols or β-sitosterol were added to test meal.

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