# Effects of Diethanolamine (DEA) on Rats Fed Atherogenic Diets.* (24684)

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Diethanolamine has been shown to affect the lipide composition of the liver, and to be incorporated into a phospholipide analogous to phosphatidyl-ethanolamine (Artom, *et al.* (1-3)). Clarkson, *et al.*(4), and King *et al.* (5) reported that diethanolamine salt of camphoric acid ester of 4,dimethylbenzyl alcohol (Gallogen®) suppressed elevation of cholesterol in tissues and serum of cockerels fed cholesterol-rich diets. Subsequent studies have suggested that DEA is the active moiety of this molecule(6,7). Quite recently, Dayton(7), using rats on hypercholesterolizing diets found that Gallogen® and DEA both depressed liver cholesterol, but increased further the cholesterol level in serum. In the present experiments rats were also used, but hypercholesterolizing diets contained a high proportion of fats with different degrees of unsaturation. When a fat low in unsaturated fatty acids (hydrogenated coconut oil) was fed, DEA reduced significantly liver lipides, liver cholesterol, aortic cholesterol, and serum cholesterol. However, these effects of DEA were not apparent when a more unsaturated fat (corn oil) was included in the diet.

*Methods.* Male albino rats of Wistar MW-2 strain† with initial weight 50 to 80 g, were placed on hypercholesterolizing diets similar to those described by Fillios, *et al.*(8). The exact compostion of diets is presented in Table I. After 4 weeks on experimental diets, the rats were anesthetized with ether and 1 ml blood sample obtained by cardiac puncture for total serum cholesterol. The rats were killed by exsanguination after 8 weeks on the diets. Livers were removed, weighed, and minced immediately under alcohol. Lipides were extracted with hot alcohol and alcohol-ether, and purified with chloroform(9). On aliquots of liver lipides, the weight of the chloroform extract ("total lipides"), total cholesterol(10) and lipide phosphorus(11) were determined. The thoracic aorta was removed, cleared of adhering extraneous tissue, and weighed. After mincing in alcohol, the aortas were extracted with alcohol-ether. For cholesterol determination on aorta and serum, the Abell procedure(10) was used.

*Results* of our determinations of serum cholesterol are presented in Table II. At the end of fourth week there were no significant differences between cholesterol levels in sera of DEA treated rats and those of corresponding controls. At this time, average level of cholesterol in serum of rats fed corn oil was not as high as in rats fed coconut oil. On the other hand, it appears that after 8 weeks, DEA was quite effective in lowering serum cholesterol, when hydrogenated coconut oil was the fat component of the diet. There was no such effect of DEA when corn oil was fed for same length of time. The discrepancy between our results and those of Dayton is possibly due to differences in level and type of fat included in the diet.

Results of analyses of liver and aorta are also shown in Table II. In both tissues, DEA lowered the cholesterol level when the diet contained coconut oil, but had no significant effect in corn oil-fed groups. In liver, total lipides were depressed by administration of

TABLE I. Composition of Diets.

| Dietary ingredients* | Group No. I | II | III | IV |
|---|---|---|---|---|
| Hydrogenated coconut oil† (30%) | + | + | — | — |
| Corn oil (30%) | — | — | + | + |
| Diethanolamine HCl (.05%) | — | + | — | + |

* Diets contained, in addition to substances listed above, vitamin free casein, 30%; sucrose, 21.2%; starch, 21.2%; salt mixture, U. S. P. XII, 4%; Alphacel (Nutritional Biochemicals Corp.), 2%; thiouracil, 0.3%; cholesterol, 1%; sodium cholate, 0.3%; and vit supplement (Vit Diet Fortification Mixture, complete, Nutritional Biochemicals Corp.), 2.2%.

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† Obtained from Manor Farms, Staatsburg, N. Y.

TABLE II. Effects of Diethanolamine (DEA) Added to Atherogenic Diets.*

| Group No.† | Rat body wt (g) | Aorta cholesterol (mg)‡ | Serum cholesterol (mg)§ 4 wk | Serum cholesterol (mg)§ 8 wk | Liver lipides (mg)‖ Cholesterol | Liver lipides (mg)‖ Phospholipides¶ | Liver lipides (mg)‖ Total lipides |
|---|---|---|---|---|---|---|---|
| I. Coconut oil (25) | 181.0 ± 4.7 | 7.1 ± .6 | 537.0 ± 26.0 | 2220.1 ± 174.2 | 513.1 ± 29.1 | 181.3 ± 3.1 | 1051.2 ± 35.0 |
| II. Coconut oil & DEA (25) | 193.7 ± 5.7 | 4.5 ± .1 | 527.0 ± 29.1 | 1428.6 ± 128.1 | 264.4 ± 17.9 | 141.2 ± 9.1 | 697.0 ± 38.1 |
| III. Corn oil (24) | 200.6 ± 5.5 | 4.5 ± .1 | 442.3 ± 22.4 | 732.3 ± 62.2 | 512.3 ± 57.8 | 145.0 ± 8.0 | 980.1 ± 62.2 |
| IV. Corn oil & DEA (18) | 195.1 ± 5.4 | 4.9 ± .3 | 448.7 ± 28.3 | 757.0 ± 50.0 | 414.2 ± 42.1 | 163.2 ± 7.9 | 922.0 ± 66.0 |

* Avg values, followed by stand. errors of means. † No. of rats in parentheses.
‡ Values/g of aorta (wet). § Values/100 ml serum. ‖ Values/whole liver of a 100 g rat.
¶ Lipide P × 25.

DEA, but significantly only in rats fed coconut oil. In the latter animals, DEA also appeared to reduce liver phospholipides, whereas in rats fed corn oil, the results were in the opposite direction.

The present experiments shed little light on the mechanism of the action of DEA. Inasmuch as phospholipide synthesis in liver appears to be affected by this compound(1-3), it seems possible that our results reflect changes in mobilization from the liver, and/or in transport of lipides in plasma. For the present, however, any such interpretation must be purely speculative.

*Summary.* In rats fed hypercholesterolizing diets, DEA significantly reduced liver lipides, liver cholesterol, aortic cholesterol, and serum cholesterol, when the fat component was hydrogenated coconut oil. There was no effect of DEA when dietary fat was corn oil.

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