*Summary.* These data suggest the following tentative conclusions: 1. Adrenal 17-hydroxycorticoids appear to exert an effect on utilization of acetate and to decrease oxidation of this 2 carbon fragment to $CO_2$. 2. In the human as in tissues of lower animals and in plant seeds, carboxyl carbon of acetate is more readily oxidized than is methyl carbon. The finding of a decrease in lipid synthesis form methyl labeled acetate in association with a decrease in oxidation of this compound as compared to carboxyl labeled acetate suggests that the carboxyl carbon may also be used preferentially for lipid synthesis in the human. 3. The syndrome of lipoatrophic diabetes appears to be associated with a decreased ability to store and perhaps to synthesize lipids in the adipose tissue rather than an increase in utilization of lipids of adipose tissue. 4. The stable adult diabetic may have a defect in conversion of 2 carbon fragments to fatty acids, even when the fasting blood sugar is normal.

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## Effect of Dietary Sucrose and Glucose on Plasma Cholesterol in Chicks and Rabbits.* (24588)

W. C. GRANT† AND M. J. FAHRENBACH
*American Cyanamid Co., Pearl River, N. Y.*

The influence of certain components of diet on level of cholesterol in blood has been the subject of much investigation and speculation. That type of protein used may alter cholesterol level was indicated as early as 1940(1), and the association of different types of fat with various serum cholesterol values has also been described(2). In many such studies the effect of carbohydrate has not been considered. However, it has recently been reported (3) that cholesterol-fed rats developed significantly higher serum cholesterol levels when sucrose was substituted for starch in the diet. A similar but less pronounced effect was noticed when sucrose replaced glucose. The purpose of this study was to investigate the difference between glucose and sucrose in regulation of plasma cholesterol in chicks and rabbits.

*Methods.* Day-old single-comb White Legborn male chicks‡ were given water and purified basal diets (Table I) *ad lib.* with appropriate supplementation for 28 days. At end of this period blood was removed by heart

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† Present address: VA Hospital, Coral Gables, Fla.

‡ Obtained from Kerr Chickeries, Frenchtown, N. J.

TABLE I. Purified Basal Diets for Chicks.

*(a) Constant ingredients*

| | g | | mg |
|---|---|---|---|
| Corn oil | 3 | Thiamine | 1 |
| Ca gluconate | 5 | Riboflavin | 1 |
| Salt mixture | 2* | Niacinamide | 5 |
| Bone ash | 2 | Pyridoxine | 1 |
| Choline chloride | .2 | Ca pantothenate | 5 |
| Inositol | .1 | Menadione sodium bisulfite | .5 |
| | | Folic acid | .5 |
| | | Tocopherol acetate | .5 |

| | Units | | μg |
|---|---|---|---|
| Vit. A | 1000 | Biotin | 20 |
| $D_3$ | 200 | Vit. $B_{12}$ | 5 |

*(b) Variable ingredients*

| | Diet 1 | Diet 2 | Diet 3 |
|---|---|---|---|
| | g | | |
| Sucrose | 0 | 60 | 0 |
| Glucose† | 64 | 0 | 60 |
| Casein | 0 | 20 | 20 |
| Gelatin | 0 | 8 | 8 |
| Soybean protein‡ | 25 | 0 | 0 |
| L-cystine | 0 | .4 | .4 |
| DL-methionine | .7 | 0 | 0 |
| Cholesterol | 0 or 3 | 0 or 3 | 0 or 3 |

* Final concentration of salts in the diet: NaCl 0.6, $K_2HPO_4$ 0.6, $KH_2PO_4$ 0.45, $MgSO_4$ 0.25, $MnSO_4 \cdot H_2O$ 0.04, $FeC_6H_5O_7 \cdot 3H_2O$ 0.05, $CuSO_4 \cdot 5H_2O$ 0.002%. KI 6, $Zn(C_2H_3O_2)_2$ 14, $Al_2(SO_4)_3 \cdot 18H_2O$ 16, $Co(C_2H_3O_2)_2 \cdot 4H_2O$ 4, $NiCl_2 \cdot 6H_2O$ 2, KBr 8, $Na_2MoO_4 \cdot 2H_2O$ 0.5 parts/million.

† Cerelose.

‡ Assay protein C-1, Archer-Daniels-Midland Co., Cincinnati, O.

puncture, heparinized and the plasma analyzed for cholesterol(4). Chicks were treated in groups of 8 to 10. Male Dutch Belted rabbits,§ weighing 1.5 to 2.0 kg, were maintained for 60 days in individual cages. They were fed a purified diet containing soybean protein 25%, methionine 0.3%, cellophane 'spangles' 10%, corn oil 5%, cholesterol 1%, and choline chloride 0.15% with complete vitamin and salt mixture(5). One group of 15 was given 50% glucose while the other had 50% sucrose in the diet. Blood was removed by heart puncture for cholesterol analysis(4).

*Results.* Plasma cholesterol of 7 groups of chicks which were fed Diet 1 with cholesterol 3% reached average level of 296 mg % after 28 days (Table II). Seven other groups receiving Diet 2 with cholesterol 3% developed average plasma cholesterol value of 601 mg %, which was significantly ($p<0.01$) higher than the average value on glucose-soybean protein diet. When these diets were fed without added cholesterol, average cholesterol values were 170 mg % and 177 mg % respectively.

To determine whether a similar difference in plasma cholesterol concentration would result

§ From Research Animal Center, Nanuet, N. Y.

TABLE II. Effect of 2 Purified Diets on Plasma Cholesterol Levels of 28-Day-Old White Leghorn Cockerels.

| Added dietary cholesterol (%) | Plasma cholesterol levels* (mg % ± S.E.) of chicks fed Diet 1† | Diet 2† |
|---|---|---|
| 0 | 190 ± 19 | 169 ± 28 |
| | 172 ± 22 | 184 ± 80 |
| | 136 ± 20 | 219 ± 42 |
| | 214 ± 38 | 192 ± 42 |
| | 162 ± 20 | 147 ± 32 |
| | 147 ± 30 | 155 ± 56 |
| Mean | 170 ± 27 | 178 ± 24 |
| 3 | 346 ±141 | 636 ±310 |
| | 242 ± 59 | 428 ±194 |
| | 241 ± 54 | 721 ±369 |
| | 338 ±118 | 635 ±165 |
| | 353 ±117 | 425 ±116 |
| | 326 ±114 | 645 ±120 |
| | 228 ± 72 | 714 ±185 |
| Mean | 296 ± 54 | 601 ±113 |

* Each cholesterol value represents a single experiment and is avg plasma cholesterol level resulting from individual determinations on 8 to 10 chicks.

† See Table I.

TABLE III. Comparative Effects of Glucose and Sucrose on Plasma Cholesterol Values of 28-Day-Old White Leghorn Cockerels Fed Purified Diets.

| Added dietary cholesterol (%) | Plasma cholesterol levels* (mg % ± S.E.) of chicks fed Diet 3† | Diet 2† |
|---|---|---|
| 0 | 110 ± 31 | 155 ± 56 |
| | 242 ± 23 | 179 ± 19 |
| | 183 ± 51 | 192 ± 42 |
| | 175 ± 95 | 147 ± 32 |
| | 118 ± 4 | |
| Mean | 166 ± 47 | 168 ± 20 |
| 3 | 360 ± 73 | 645 ±120 |
| | 486 ±118 | 752 ±134 |
| | 452 ±189 | 635 ±165 |
| | 380 ±153 | 425 ±116 |
| | 470 ±178 | 714 ±185 |
| Mean | 430 ± 46 | 634 ±114 |

* Each cholesterol value represents a single experiment and is avg plasma cholesterol level resulting from individual determinations on 8 to 10 White Leghorn cockerels after 28 days on experimental diets.

† See Table I.

TABLE IV. Effect of Glucose *vs* Sucrose on Plasma Cholesterol Values of 28-Day-Old White Leghorn Cockerels Fed a Crude Diet.

| Added dietary cholesterol (%) | Plasma cholesterol levels* (mg % ± S.E.) of chicks fed a crude diet† containing | |
|---|---|---|
| | Glucose 50% | Sucrose 50% |
| 0 | 113 ± 1.4 | 113 ± 7.9 |
| 3 | 359 ±131.3 | 627 ±197.0 |

* Each plasma cholesterol value is avg of individual determinations on 10 White Leghorn cockerels after 28 days on experimental diets.

† Composition of diet: Fish meal 25, fish solubles 5, alfalfa meal 2, casein 5, distillers solubles 5, choline chloride .05, corn oil 3, carbohydrate 50, NaCl 0.25, Ca 0.33, Mn 0.002, I 0.00045%; vitamins were same as employed in purified basal diet, Table I.

when only the carbohydrate component was varied, the Diets 2 and 3 were compared. After 28 days on these diets with 3% added cholesterol, 5 groups on glucose supplemented diet had cholesterol values averaging 430 mg % while 5 on sucrose had 634 mg %. This was a significant difference ($p<0.01$). When no cholesterol was added, values were 166 mg % and 168 mg % respectively.

The effect of glucose or sucrose in another diet containing varied and cruder protein sources is shown in Table IV. As in the previous experiment when glucose was the carbohydrate, in the presence of 3% cholesterol plasma cholesterol values averaged 359 mg % after 28 days, whereas with sucrose the value was 627 mg % ($p<0.02$). When no cholesterol was added, plasma cholesterol levels were not significantly different.

In experiments with rabbits, 2 groups of 15 male Dutch Belted rabbits were fed a diet containing soy protein; one group received glucose 50% and the other sucrose 50% as sole carbohydrate. After 60 days the rabbits on glucose diet had an average plasma cholesterol concentration of 1015 mg % while those on sucrose had 1539 mg % ($p = 0.02$).

*Discussion.* Higher plasma cholesterol levels were obtained in chicks and rabbits when sucrose was substituted for glucose as the sole source of carbohydrate in various purified diets. A preliminary trial with fructose as the only dietary carbohydrate suggested that it produced extremely high cholesterol levels in chicks but this experiment was unsatisfactory because of pronounced growth depression.

One may speculate that sucrose favors absorption of exogenous cholesterol. This reasoning is suggested by the observation that there was no difference in plasma cholesterol when either glucose or sucrose was fed without added cholesterol.

*Summary.* Chicks were fed purified diets containing 3% cholesterol and either casein, gelatin and sucrose or soybean protein and glucose together with vitamins and minerals. The chicks receiving casein, gelatin and sucrose had higher plasma cholesterol values than did those whose diet contained soy protein and glucose. When both diets contained casein and gelatin, those chicks on the diet containing sucrose as sole carbohydrate source had higher plasma cholesterol values than did those on a diet containing glucose; when these same diets were fed without the addition of 3% cholesterol, no significant difference in plasma cholesterol concentrations was found. Serum cholesterol values of rabbits fed a cholesterol diet containing sucrose were higher than those from a group on a similar diet containing glucose.

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