activities but occurs too late to explain the early metabolic events mentioned in this and previous papers(1,2,4).

Summary. Measurements of incorporation of ^{14}C from differentially labelled glucose and pyruvate into uterine lipid and CO_2 were used to evaluate early metabolic changes produced by estradiol in immature rat uterus. Tissue was incubated with the isotopes *in vitro* after hormone treatment *in vivo*. With pyruvate-3-^{14}C as substrate, substantially more $^{14}CO_2$ is produced than with glucose-1-^{14}C or glucose-6-^{14}C as substrates. Also, $^{14}CO_2$ output from glucose-1-^{14}C is about double that from glucose-6-^{14}C. Estradiol treatment causes a similar increase of ^{14}C incorporation into lipid with either of the glucose substrates or with pyruvate. This suggests that the estradiol effect on lipid synthesis is beyond pyruvate. A differential effect on $^{14}CO_2$ production from glucose and pyruvate, however, locates an estradiol effect between these substrates. Furthermore, the estradiol acceleration of $^{14}CO_2$ production from glucose-1-^{14}C and glucose-6-^{14}C is equal. This suggests that the site of estrogen stimulation of uterine glucose metabolism is prior to the formation of glucose-6-phosphate and therefore implicates the transport step, the phosphorylation step, or both.

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Effect of Guar Gum and Pectin N. F. on Serum and Liver Lipids Of Cholesterol Fed Rats. (31844)

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Previous studies in our laboratory(1) have demonstrated the hypocholesterolemic effect of 16 mucilaginous polysaccharides in White Leghorn cockerels fed a semi-purified diet supplemented with dietary cholesterol. Because our results on the relative order of activity of the various mucilaginous polysaccharides in the chick did not agree with those of Ershoff and Wells in the rat(2), it appeared of interest to carry out several experiments in rats comparing guar gum and pectin N. F. under similar conditions.

Methods. Two basal diets were employed. The first of these was a casein-sucrose basal diet similar to that employed by Ershoff and Wells(2); the composition of this diet has been previously reported(3). The second diet was powdered Purina Lab Chow. In the casein-sucrose basal diet, test substances (including 1% cholesterol and 10% corn oil) were added at the expense of carbohydrate; in the Purina Lab Chow basal diet, test substances (including 1% cholesterol and 5% corn oil) were added at the expense of the

TABLE I. Effects of Dietary Supplements on Serum and Liver Cholesterol and Liver Total Lipids of Rats Fed a Cholesterol-Supplemented Casein-Sucrose Diet(1) (6 Animals/Group).

Group	Supplements fed with basal ration*	Results at the end of 28 days: Body wt (g)†	Serum total cholesterol (mg/100 ml)†	Liver total cholesterol (mg/g)†	Liver total lipid (%)†
1	None	219 ± 4.2	106 ± 3.3	1.81 ± .07	4.50 ± .22
2	1% cholesterol	227 ± 15.0	146 ± 14.6	15.50 ± 1.97	9.75 ± .87
	Idem + following supplements:				
3	5% pectin N. F.	226 ± 4.2	147 ± 6.9	10.63 ± 1.48	9.95 ± 1.22
4	10% " "	197 ± 16.6	132 ± 6.3	9.20 ± 1.08	7.87 ± .64
5	5% guar gum	217 ± 2.6	134 ± 8.0	10.12 ± 1.02	8.56 ± .34
6	10% " "	194 ± 5.5	105 ± 12.2	4.53 ± .62	5.82 ± .48

* Pectin N. F. (citrus) obtained from Sunkist Growers, Ontario, Calif.; methoxyl content 10.5% on a moisture-ash-free basis. Guar gum (A-20-D) obtained from Stein, Hall and Co., Inc., New York.

† Mean ± standard error of mean.

diet. Carworth Farms rats (CFE strain),* 42-55 g, were divided into groups of 6, and each animal was housed individually with food and water *ad libitum*. Body weight and food consumption were determined weekly. At the end of 28 days on the experimental diets, final body weight and total food consumption were recorded for each animal, then the rats were anesthetized with sodium pentobarbital, and a 5.0 ml blood sample was taken *via* heart puncture. Livers were excised, blotted to remove excess fluid, weighed and stored in a freezer until analyzed. Total liver lipids were determined by the method of Shipley *et al*(4), and total cholesterol was determined on the serum and liver by a modification of the Leffler procedure(5) adapted for use on a Technicon AutoAnalyzer.

Results. Data on body weight, serum and liver cholesterol and liver lipids produced by feeding a casein-sucrose diet supplemented with 1% cholesterol and 10% corn oil to rats over a 28-day period are summarized in Table I. The feeding of 10% guar gum or 10% pectin N. F. (Groups 4 and 6) appeared to cause a slight decrease in body weight gain; however, these decreases were not statistically significant from the non-cholesterol- or cholesterol-supplemented control groups (Groups 1 and 2) at the 5% probability level.

Small decreases in serum cholesterol were observed when 5% guar gum and 10% pectin N. F. were incorporated into the diet; however these changes were not statistically significant at the 5% probability level (Groups 4 and 5 *vs* Group 2); on the other hand, feeding of 10% guar gum lowered serum cholesterol to the level of the control group unsupplemented with cholesterol (Group 6 *vs* Group 1).

Liver cholesterol (mg/g) was reduced from the cholesterol-supplemented control (Group 2) with all levels of agents tested; however, 10% guar gum produced a significantly greater reduction than 10% pectin N. F. (Group 6 *vs* Group 4, $p \leqq 0.05$).

Liver total lipids were also decreased with 10% pectin N. F. and 5% and 10% guar gum. However, statistical significance was obtained only with the 10% level of guar gum (Group 6 *vs* Group 2, $p \leqq 0.05$).

A similar experiment was carried out in rats in which the casein-sucrose basal diet was replaced with a powdered Purina Lab Chow diet plus 5% corn oil. The data on body weight, serum and liver cholesterol and liver lipids are summarized in Table II.

Body weight gain was decreased in the groups receiving 10% pectin (Group 4) and 5% and 10% guar gum (Groups 5 and 6) compared to the cholesterol-supplemented control (Group 2); a significant reduction was obtained only with 5% guar gum (Group 5, $p \leqq 0.05$).

Small decreases in serum cholesterol levels

* Obtained from Carworth Farms Inc., New City, N. Y.

TABLE II. Effects of Dietary Supplements on Serum and Liver Cholesterol and Liver Total Lipids of Rats Fed a Cholesterol-Supplemented Powdered Purina Lab Chow Diet (6 Animals per Group).

		Results at the end of 28 days			
Group	Supplements fed with basal ration*	Body wt (g)†	Serum total cholesterol (mg/100 ml)†	Liver total cholesterol (mg/g)†	Liver total lipid (%)†
1	None	212 ± 5.5	96 ± 1.8	1.80 ± .07	4.58 ± .14
2	1% cholesterol	218 ± 5.2	90 ± 3.1	5.76 ± .31	6.03 ± .18
	Idem + following supplements:				
3	5% pectin N. F.	217 ± 2.7	94 ± 5.3	4.60 ± .50‡	5.60 ± .21
4	10% " "	209 ± 6.0	85 ± 3.8	4.28 ± .53	5.85 ± .25
5	5% guar gum	188 ± 3.9	87 ± 8.2	3.10 ± .28‡	5.15 ± .28
6	10% " "	196 ± 9.3	76 ± 6.3	3.58 ± .58	5.60 ± .37

* Pectin N. F. (citrus) obtained from Sunkist Growers, Ontario, Calif.; methoxyl content 10.5% on a moisture-ash-free basis. Guar gum (A-20-D) obtained from Stein, Hall and Co., Inc., New York.

† Mean ± standard error of mean.

‡ 5% guar gum *vs* 5% pectin N. F., $p \leq 0.05$.

were observed with the high levels of pectin N. F. and guar gum (Groups 4 and 6), but these were not statistically significant at the 5% probability level.

Liver sterols were reduced with all levels of the agents tested, but a statistically significant reduction was obtained only with 5% guar gum (Group 2 *vs* Group 5, $p \leqq 0.05$). Five per cent guar gum gave a greater reduction in liver sterols than an equal amount of pectin N. F. (Group 3 *vs* Group 5, $p \leqq 0.05$).

Minor reductions were observed in total liver lipids of all treated groups compared to the cholesterol-supplemented control (Group 2), but once again only 5% guar gum (Group 5) was significantly different ($p \leqq 0.05$).

The results obtained with the powdered Purina Lab Chow basal diet were not as dramatic as those obtained with the casein-sucrose basal diet; however, it should be noted that supplementation of this diet with 1% cholesterol (Group 2) did not cause an increase in serum cholesterol, and the increases in liver cholesterol and liver total lipids over the non-supplemented control (Group 1) were not as great as those observed when the casein-sucrose basal diet was employed (Table I).

Discussion. The administration of guar gum and pectin N. F. to rats decreased liver sterols and liver total lipids induced by the feeding of 1% cholesterol. Our results on the relative order of activity of these agents in the rat do not agree with those of Ershoff and Wells(2), but do agree with our results in the chick(1); that is, guar gum has a greater order of hypocholesterolemic activity than pectin N. F. Ershoff and Wells(2) stated that pectin N. F. with maximal activity was obtained only when the methoxyl content, on a moisture-ash free basis, was relatively high in the range of 10.7%, and that inactive preparations resulted when the methoxyl content was 5% or less. All of our experiments were carried out with pectin N. F. which assayed 10.5% methoxyl and was also obtained from a citrus source. Therefore, it would appear that this parameter does not account for the different relative order of activity observed with pectin N. F. in our experiments in rats.

The casein-sucrose basal diet employed in these experiments differed from that of Ershoff and Wells(2) in the following respects: their complete diet contained more sucrose (10%), casein (4%) and salt mixture (3%) than our diet; furthermore, our diet contained 2% bone ash, 5% calcium gluconate and 8% gelatin which were not present in their diets. These alterations in the composition of the basal diet could possibly account for the differences in our results.

Supplementation of a powdered Purina Lab Chow diet with 1% cholesterol did not cause the marked increases in serum and liver cholesterol levels and liver lipids of the rat obtained with the casein-sucrose basal diet; although these elevations were much less, guar gum still demonstrated greater hypocholesterolemic activity than pectin N. F. Similar results had been previously observed in our experiments with chickens(1) fed either the casein-sucrose basal diet or a commercial-type diet prepared from a variety of natural foodstuffs from vegetable or animal sources.

Summary. The oral administration of guar gum and pectin N. F. to rats in a casein-sucrose basal diet greatly reduced the elevations in liver sterol and total liver lipids produced by the feeding of 1% cholesterol. Similar results were also obtained in rats when a powdered Purina Lab Chow diet was employed. Guar gum was considerably more active than pectin N. F., which confirms the results of similar experiments previously carried out with chickens.

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Effect of Advancing Age on Thyroid Hormone Secretion Rate of Male and Female Rats.* (31845)

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A number of reports have been presented concerning the depression of thyroid function with advancing age in domestic and laboratory animals(1-14). Recently, a study was reported on the effect of advancing age (from 25 to 115 days) on the thyroid hormone secretion rate (TSR) of female rats(15). It was observed that the TSR of the same rats at 25 days was 1.52 μg L-thyroxine (L-T_4)/ 100 g bw and gradually declined to a level of 0.88 μg/100 g bw at 115 days.

Levey determined the TSH concentration in the pituitary of rats by a bio-assay from birth to 56 days of age and noted a progressive increase from 13 mμ/mg to over 100 mμ/mg(16). It has been observed that the pituitary and plasma levels of TSH were low at weaning time and gradually increased until 80 or 95 days of age, then showed a slight decline(17). The present investigations were undertaken to study the effect of age on the TSR of male rats from weaning time until they were about 4 months of age, at 30-day intervals since no data were available on the TSR of the male rats of increasing age. The effects of aging upon TSR in female rats were studied from weaning time up to 8 months of age.

Materials and methods. The TSR determination of 36 male and 29 female rats of the Sprague-Dawley-Rolfsmeyer strain, bred in this laboratory and maintained at a temperature of 78 $\pm$ 1°F, with 14 hours of light and 10 hours of darkness, was started when they were 30 days of age. The mean body weight of the males was 151 g and of the females was 117 g. In addition to these 2 groups, the TSR was estimated in a total of 118 male rats at 30 days of age. Carrier-free I^{131} was diluted in distilled water to contain 3 μc/ml for the first month and later 10 μc/ml was administered to each rat intraperitoneally.

The determination of TSR of the growing rats was based on a slight modification of the technique described by Grosvenor and

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