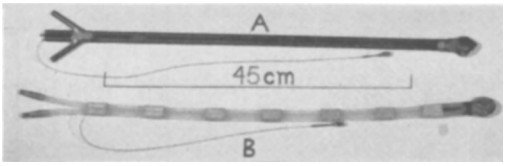

FIG. 1. (A) Original brass-tubed, "George Wright" tracheal divider. (B) Polyethylene-tubed modification of "George Wright" tracheal divider.

bifurcation. The right main stem bronchus leaves the carina at a much more acute angle than before excision, and separation of right from left lung becomes extremely difficult because the divider "head" slips by the bifurcation and lodges in the right main stem bronchus. Examination of a plastic cast of the tracheobronchial tree in the carina region revealed that no bronchi originate along the internal edge of the carinal bifurcation (for at least 3 cm). A new divider "head" was constructed with prongs that are simple projections of the brass tubes filed into the shape shown in Fig. 2. Each prong tip was blunted with a rounded drop of lead solder to prevent scratching the trachea when inserting the divider.

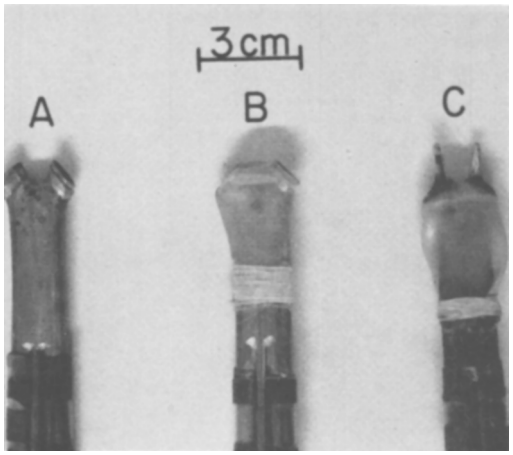

FIG. 2. (A) "George Wright" tracheal divider "head" without balloon. (B) "George Wright" tracheal divider "head" with balloon. (C) Pronged modification of "George Wright" tracheal divider "head" with balloon.

Summary. Two modifications of the "George Wright" canine tracheal divider have been made. They are: 1) substitution of polyethylene for brass tubing, and 2) addition of prongs to the divider head. Inadvertent pulmonary artery obstruction is prevented, and the divider does not slip past the carina.

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Effect of Antibiotics on Growth of Lactose-Fed Rat. (24400)

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Use of the rat in nutritional studies of human milk is complicated by its intolerance to high concentration of lactose. Symptoms of lactose toxicity are intense diarrhea for the first few weeks, untidy bloated appearance, retarded rate of growth, polydipsia, polyuria, galactosuria, and after prolonged feeding cataracts appear(1). Since high levels of dietary galactose will produce most of these symptoms, it is sometimes assumed that toxicity of lactose is due entirely to its galactose component. However, feeding lower levels of lactose will produce a growth retardation that is not duplicated by an equivalent mixture of glucose and galactose(2,3), thus the intact disaccharide is implicated rather than its digestion product. Because of incomplete digestion and absorption, considerable amounts of lactose reach the lower intestine, resulting in an increase in bacterial population (1). The adverse effect of lactose feed-

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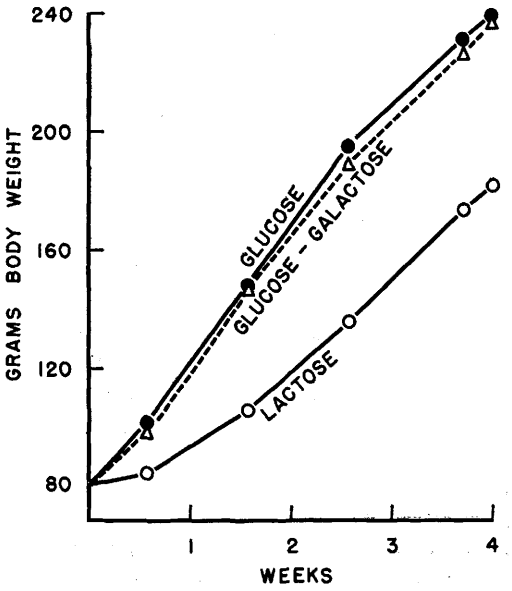

FIG. 1. Effect of dietary carbohydrate on growth rate.

ing has been ascribed to this increased bacterial action in the intestinal tract, either through an interference with the utilization of nutrients or by production of toxic metabolites(1). The effect of antibiotics on growth retardation produced by a high-lactose diet was studied to investigate this possibility.

Methods. The basal diet consisted of casein, 242; lactose, 520; fat mixture of corn, palm, soybean and oleo oil, 198; salt mixture, 40 (4); and vitamins.† Lactose in this diet as in human milk supplied 43% of the calories.

The antibacterial agents used included several that would be expected to be particularly effective in the intestinal tract. The concentrations of the antibiotics chosen were those shown by Dick and Johansson to produce a marked alteration of the intestinal flora of the rat(5). The antibiotic was diluted with lactose before admixture into the diet.

Results. Rats fed the basal diet grew at about two-thirds the normal rate (Fig. I). When the lactose of the diet was replaced with an equivalent mixture of glucose and galactose, *i.e.* 26% each, rate of growth was equal to that of the group fed glucose.

Enlargement of the cecum found in lactose-fed rats was not present in the group fed the glucose-galactose mixture. Average cecum weights were: lactose, 0.98; glucose-galactose, 0.42; and glucose 0.38, (g/100 g body weight).

In the experiment of Table I, after 28 days of feeding, the antibiotic groups, with the exception of carbomycin B, were heavier than the control. The weight differences were not large and with the variation present only the chlortetracycline group was significantly heavier than the control ($p = 0.05$). The

TABLE I. Effect of Antibiotics on the Growth of Lactose-Fed Rats.

Group*	Antibiotic, 100 mg/kg	Gain (g) ± S.E. 28 days		42 days		Cecum, g/100 g
A	None	96	7.2	166	10.5	.80
B	Chlortetracycline†	121	6.0	195	8.9	.93
C	Benzathine penicillin G‡	116	6.0	192	10.7	.87
D	Bacitracin§	105	7.4	173	3.1	.86
E	Carbomycin B‖	97	5.0	162	6.3	.99
F	Polymixin B¶	110	4.0	188	9.0	.75
G	(Glucose control)	159	6.1	288	12.5	.30

* 6 rats/group. † Aureomycin HCl, Lederle. ‡ Bicillin, Wyeth. § Pfizer, 55 u/mg. ‖ Magnamycin, Pfizer. ¶ Pfizer, 7105 u/mg.

effect of the penicillin was of borderline significance ($p = 0.08$).‡ During the next 2 weeks all groups grew at about the same rate, 35 g/week, so that at the 42nd day the absolute weight differences between the groups were the same as at the 28th day. At the later date only the chlortetracycline group was significantly different than the control. Antibiotics had no effect on the cecum size.

The growth promoting effect of chlortetracycline was confirmed in a second experiment, (Table II). The difference in weight gain between the chlortetracycline and control groups was highly significant at both 28 and 42 days ($p = < 0.01$). Again the absolute

† 1 g of choline chloride; 5 mg each of thiamine HCl, riboflavin, pyridoxine HCl and 2-methyl napthoquinone; 50 mg each of niacin and calcium pantothenate; 100 mg each of inositol and p-aminobenzoic acid; 2 mg folic acid; 0.5 mg of biotin and 50 μg of vit. B_{12}/kg of diet. Fat soluble vitamins given by dropper, 2 drops twice weekly—30 mg tocopherol, 4400 I.U. vit. A, 600 I.U. vit. D/g of corn oil.

‡ Student's t test, 0.05 or less considered significant.

TABLE II. Effect of Antibacterial Agents on Growth of Lactose-Fed Rats.

Group*	Antibacterial agent	Per kg diet	Gain (g) ± S.E. 29 days		46 days		Cecum size, g/100 g
A	None		126	7.2	187	6.4	.89
B	Chlortetracycline	100 mg	147	3.0	208	4.0	.80
C	Sulfathalidine	20 g	129	9.0	197	10.1	.89
D	Polymagma†	50 ml†	129	9.0	183	12.5	.86
E	(Glucose control)		183	4.5	258	7.5	.21

* 7 rats/group.

† 500 mg dihydrostreptomycin, 200,000 units polymixin B, 5 g attapulgite and 450 mg pectin, Wyeth.

difference in weight gain was the same at the 42nd day as at the 28th day indicating that the growth-promoting action of the antibiotic was effective only during the early part of the experiment. Sulfathalidine and the dihydrostreptomycin - polymixin preparation were ineffectual. The weight difference between groups A and C at 46 days was not statistically significant ($p = 0.3$). The cecum size was not reduced by the antibacterial agents. The improved growth rate of the aureomycin group was not the result of a more efficient utilization of food; the lactose group gained 0.31 g per g of food, the aureomycin group, 0.32 g/g.

Rats fed lactose are characterized by a low body fat content, 8 compared to 14% in a rat fed a glucose diet(6). The increased body weight of the chlortetracycline-supplemented rat was not due to increased fat deposition. Carcass analysis values for the chlortetracycline and control groups respectively were: protein, 20.9, 21.4; fat, 8.4, 9.5; water, 60.1, 60.7.

During the first 2 weeks the rats suffered from diarrhea. There was no correlation between severity of the diarrhea and rate of growth, and the antibiotics had no effect on duration nor severity of the diarrhea.

Discussion. The retarded growth of young rats fed a diet containing lactose in the caloric proportion present in human milk does not occur with an equivalent mixture of glucose and galactose. Thus under these particular dietary conditions, the adverse effect must be attributed to the intact disaccharide. Involvement of intestinal bacteria is suggested by growth stimulation produced by chlortetracycline and to a lesser degree by penicillin. On the other hand, carbomycin, polymixin, bacitracin, sulfathalidine and the Polymagma mixture had little or no effect. The antibiotics of the latter group are relatively insoluble and would be expected to be present in the intestinal tract in higher concentrations for longer periods. The effectiveness of the more readily absorbed chlortetracycline suggests that the beneficial antibacterial effect may be extra-intestinal. If growth stimulation is mediated through alterations in the intestinal flora then it must be assumed that the pertinent organisms are more sensitive to aureomycin and penicillin than to the less readily absorbed antibiotics.

Other investigators have fed antibiotics in lactose diets to rats. De Groot and Engel(7) reported no increase in growth rate when penicillin, streptomycin, and chloromycetine were fed with a grain and meat or milk diet containing 25% lactose. Lee and Moinuddin(8) found chlortetracycline-fed rats tended to exceed controls in weight gain on a 25% lactose diet. The effect was more pronounced during the first week.

The above results are in agreement with those of the present study; chlortetracycline but not other antibiotics added to a lactose diet will definitely improve rat growth. The weight gains are small when compared to those of the glucose control and it is uncertain whether the effect is operative in the intestinal tract.

Summary. Rats fed a diet with a lactose content similar to human milk (43% of the calories) grow at a reduced rate. Normal growth was attained with an equivalent mixture of glucose and galactose, thus implicating the intact disaccharide and suggesting that the adverse effect is of intestinal bacterial origin. Chlortetracycline, and penicillin to a lesser degree, increased growth rate. Carbomycin, bacitracin, polymixin, sulfathalidine

and a dihydrostreptomycin-polymixin-pectin-adsorptive clay mixture were ineffectual despite their relatively low solubility. The characteristic low-body fat of the lactose-fed rat was not affected by chlortetracycline administration.

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Lymphocyte Output and Lymph Flow of Thoracic and Right Lymphatic Ducts of Anesthetized Rats. (24401)

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The present experiments were undertaken to ascertain rate of flow and cellular content of lymph simultaneously collected from right and thoracic lymph ducts in male rats.

Methods. Preliminary observations of lymphatic channels draining into right jugulo-subclavian angle of the rat (after injection of trypan blue) indicated that quantitative collection of right duct lymph was feasible using a procedure previously described by Reinhardt(1) for thoracic duct cannulation. Ten unfasted male Long-Evans rats about 100 days old were anesthetized by IP injection of sodium pentobarbital (7 mg/100 g body weight). The neck region was shaved and midline incision made from symphysis menti to sternal angle to expose sternohyoid muscles. Manubrium sterni was split lengthwise in the midline and the halves of the manubrium along with superficial neck muscles were retracted laterally, care being taken not to occlude or damage underlying vessels. Sternal attachments of the sternohyoid muscles were bluntly dissected away, exposing carotid arteries, vagi, and the jugulo-subclavian venous angles. Animals were tracheotomized and cervical lymphatic ducts ligated. Under dissecting microscope, thoracic and right lymphatic ducts were identified at entrance into jugulo-subclavian angles. The lymph ducts were nicked with a sharp needle and an L-shaped Pyrex capillary cannula was introduced into each duct. Lymph was collected in small vials. Coagulation of lymph was prevented by occasional application of powdered heparin to tips of cannulae. Compared to difficulties usually encountered in cannulating the right lymphatic duct in dogs, cats, and rabbits, this method is simple and successful, in most instances, in the rat. Lymph flowing through each duct was collected for various intervals (1 to 4 hours) and volume measured with graduated tuberculin syringe or micropipette. Total white cell counts were made in duplicate; all cells observed in the counting chambers were considered to be lymphocytes.

Results. Table I gives results obtained for each animal. Rate of lymph flow from thoracic duct is about 6 times as great as for right lymphatic duct. Average rates of flow, in terms of body weight, are 1.8 and 0.3 ml/hr/kg for thoracic and right lymphatic ducts respectively. Whereas lymphocyte content of thoracic duct lymph is 25% higher than that of right duct lymph, total lymphocyte output of the thoracic duct is more than 7 times that of the right duct. Total lymphocyte output, calculated/unit body weight, is 42.9 and 5.7

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