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Received July 22, 1955. P.S.E.B.M., 1955, v90.

Effect of High Levels of Fat, Lactose, and Type of Bulk in Guinea Pig Diets.* (21940)

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Woolley and Sprince(1) reported that supplements of certain inert materials, such as powdered cellophane and Cellu flour, improved the growth of guinea pigs fed purified diets. Booth *et al.*(2) who found a similar beneficial action of bulk, reported gum acacia (formerly called gum arabic) to be slightly superior to Cellu flour. However, Reid and Briggs(3) could not always obtain consistent growth with diets containing gum acacia, and turned to the use of Spangles,† a coarsely-ground cellophane product.

In this paper we are presenting further studies on the effect of different types of bulk, especially Solka-floc,‡ a very pure, finely-ground and relatively inexpensive cellulose product, on the growth of guinea pigs as well as the effect of different levels of fat and lactose.

Methods. To test the effectiveness of these different materials, 3 types of diets were devised, including a "normal", a high-fat 24% corn oil, and one with lactose as the only carbohydrate. The latter 2 diets were chosen because more information was desired on the effect of these substances on the deposition of liver fat in guinea pigs fed milk diets(4). The basal or normal diet used in this experiment provided per 100 g of ration in g: sucrose, 43; casein, 30; bulk, 15; salts IV, 4(5); corn oil, 4; potassium acetate, 2.5; choline-Cl, 0.75; magnesium oxide, 0.50; and vitamin mix, 0.25. The vitamin mix provided per 100 g of ration in mg: inositol, 200; niacinamide, 20; p-aminobenzoic acid, 10; Ca-pantothenate, 8; riboflavin, 3; thiamine-HCl, 2; pyridoxine-HCl, 2; folic acid, 1; in μg: biotin, 100; B_{12}, 4. Fat soluble vitamins were provided weekly by dropper in the following amounts: A, 2000 I.U.; D, 20 I.U.; E, 12 mg; K, 0.2 mg. It should be noted that the diets contained 2.5 times the level of choline normally used in guinea pig diets to allow for any greater need with high-fat diets. The addition of corn oil to the high-fat diets and to those with graded levels of corn oil was made at the expense of sucrose. The care and feeding of guinea pigs have been described elsewhere(6). Since the diets differed so widely, the guinea pigs were initially divided into 3 groups with each group gradually being adapted to its particular diet. After adaptation, each of the 3 dietary groups was subdivided into 3 groups of 5 guinea pigs each, with the same average starting weight within each main group (normal, 194 g; high-fat, 221 g; and lactose, 217 g). The 3 normal groups were on experiment for 4 weeks after which they were redistributed into groups averaging 380 g. These groups were fed diets with 4, 8,

* Published with the approval of the Director of the Wisconsin Agri. Exp. Station. Supported in part by a grant from the National Livestock and Meat Board.

† Rayon Processing Co., Pawtucket, R. I.

‡ Brown and Co., Berlin, N. H.

TABLE I. Comparison of Gum Acacia, Spangles and Solka-floc as Bulk for the Guinea Pig.

Diet and time	Avg growth in g/day Gum acacia	Spangles	Solka-floc
Normal, 4 wk	6.5	6.1	7.4
High-fat, 6 wk	3.8	4.5	4.9
(% liver fat wet basis)	(5.1)	(5.4)	(4.3)
Lactose, 2 wk	1.0	1.8	2.0
Lactose, 4 more wk			2.6
½ lactose & ½ sucrose, 4 wk			5.6
Graded levels of corn oil	4%	8%	12%
(Solka-floc) 3 wk	5.8	5.3	7.7

and 12% levels of corn oil with Solka-floc as the bulk for 3 weeks. The 3 groups receiving high-fat diets were on experiment for 6 weeks, after which the livers were analyzed for fat by the method of Bixby *et al.*(7). The groups receiving lactose as the carbohydrate were on experiment for 2 weeks, after which the 12 remaining animals were redivided into 2 groups. One group contained to receive lactose as the only carbohydrate, and the other group had half of the lactose replaced by sucrose. Both groups received Solka-floc as the bulk, and were on experiment for 4 weeks.

Results and discussion. The results in Table I show that of the 3 types of bulk, Solka-floc supported slightly better growth with each type of diet. The feces from the guinea pigs receiving Solka-floc were the most normal in appearance. For these and other reasons previously mentioned, Solka-floc was used as the bulk in all subsequent guinea pig diets.

The general appearance of the guinea pigs receiving the high-fat diet with gum acacia, was definitely inferior to that of the other groups, probably due in part to the fact that gum acacia is less absorbent and left a more oily ration, which tended to stick to the fur of the animals. The livers of the animals receiving the high-fat diets were almost normal in appearance and fat in content. Although the livers of the group receiving Solka-floc had slightly less fat, none of the livers were very fatty since a normal guinea pig liver will average about 4% fat.

With high-fat diets, one animal died in the group receiving gum acacia and also one in the group receiving Spangles. However, the relatively good growth observed with the group receiving high-fat with Solka-floc was somewhat surprising. This suggested that the guinea pig could utilize high levels of corn oil. Consequently, the groups of animals that had been receiving the normal diets were redistributed and given diets with graded levels of corn oil. It is apparent from Table I that the group receiving 12% corn oil grew very well, somewhat better than the groups receiving 4 or 8% corn oil. As a result of this finding the corn oil content of all guinea pig diets for subsequent experiments was raised to 7.4% to permit easier mixing and to lessen the wastage of rations that become rather dry and loose with the use of Solka-floc and only 4% corn oil.

The guinea pigs receiving lactose as the sole carbohydrate grew very poorly, as can be seen by the growth of only 2.0 g or less/day. One animal from each group died within the first 2 weeks. When the remaining animals were redivided into 2 groups, the substitution of sucrose for ½ the lactose in this diet resulted in a marked improvement in growth. This group gained an average of 5.6 g/day for 4 weeks as compared to the growth of only 2.6 g/day for the group continuing to receive lactose as the only carbohydrate. This would indicate that there is very little adaptation by the guinea pig to utilize lactose under these conditions.

The results of these experiments would also suggest that the poor growth of guinea pigs fed milk diets is primarily due to the lactose in the diets, although preliminary evidence(4) indicates that these diets may also be deficient in potassium, magnesium, arginine, and possibly other substances. Although these experiments do show that guinea pigs can utilize 12% corn oil very effectively and 24% rather well, they do not shed much light on the cause of the very fatty livers found in guinea pigs fed milk diets. The possibilities still exist that deficiencies in vitamins or amino acids or differences in kind and level of fat may be etiological factors in this condition.

Summary. Gum acacia, Spangles, and Solka-floc have been compared as bulk agents

for the guinea pig by employing normal, high-fat, and lactose diets. The average growth rate of the groups receiving Solka-floc was slightly better in all cases. Guinea pigs grew very well on diets containing 12% corn oil (7.7 g/day) and at a rate of 4.9 g/day with 24% corn oil diets using Solka-floc as the bulk. Guinea pigs fed diets with lactose as the sole carbohydrate grew at a rate of about 2.0 g/day. Substitution of sucrose for half of the lactose increased growth to over twice the rate obtained with lactose alone.

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Received July 22, 1955. P.S.E.B.M., 1955, v90.

Hydrolysis of Succinylmonocholine by a Liver Esterase.* (21941)

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Succinyldicholine (SDC), a short-acting muscle relaxant(1), has replaced to a considerable extent the older relaxants d-tubocurarine and decamethonium since its introduction in 1949(2). Little systematic work, however, has yet been reported on its mode of breakdown in the body. It is known(3) that there is little excretion of unchanged SDC after intravenous injection and that, *in vitro*, serum cholinesterase hydrolyses SDC to succinylmonocholine (SMC) and choline(4,5). This enzyme also hydrolyses SMC to succinic acid and choline, but at a much lower rate(5,6). In many patients with a low serum-cholinesterase level, a prolonged response to SDC is encountered(7,8) but it is also known that a similar abnormal prolongation of the period of relaxation after SDC administration can occur in subjects with normal serum-cholinesterase levels(9,10). It seems possible that this lack of correlation between serum-cholinesterase level and duration of relaxation may be due to the presence of another esterase which is also capable of hydrolysing SDC. It has also been suggested(11) that SMC, which itself has slight muscle-relaxant properties (12), accumulates in the body after SDC administration and potentiates the action of SDC. Since the hydrolysis of SMC by serum cholinesterase is slow, especially in the presence of SDC(5), SMC might be expected to accumulate under these conditions unless there is another esterase in the body which is also capable of hydrolysing SMC.

* We are most grateful to Messrs. Burroughs-Wellcome and Co., Inc., Tuckahoe, N. Y. for a grant which made this work possible.

It was therefore decided to determine whether esterases hydrolysing SDC or SMC are present in other tissues. The present communication concerns such an enzyme which is present in liver and which is distinct from liver cholinesterase. This enzyme catalyzes the hydrolysis of SMC but is without action on SDC.

Materials and methods. Samples of succinyldicholine dichloride and succinylmonocholine iodide were kindly supplied by Burroughs-Wellcome & Co. The rats used were a local hooded strain (170-220 g). The animals were stunned and exsanguinated, and the tissues removed and placed in cracked ice. Homogenates (17% in water) were prepared in Potter-Elvehjem type homogenizers at 0-5°C. The rates of enzymatic and non-enzymatic ester hydrolysis were followed in