

15. Mollin, D. L., and Ross, G. I. M., *J. Clin. Path.*, 1952, v5, 129.

16. Chow, B. F., Barrow, L., and Ling, C. T., *Arch. Biochem. and Biophys.*, 1951, v34, 151.

17. Lepkovsky, S., Barson, H. J., Bouthilet, R., Pencharz, R., Singman, D., Dimick, M. K., and Robbins, R., *Am. J. Physiol.*, 1951, v165, 79.

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Comparison of Some Suggested Anticariogenic Compounds in the Rat.* (22996)

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This report concerns an evaluation of 4 substances which have been suggested for reducing human dental caries by means of topical procedures. These include stannous fluoride(1,2), sodium fluoride(3), sodium oxalate (4), and sodium N-palmitoyl sarcosinate(5).

Materials and methods. A total of 280 weanling Sprague-Dawley strain rats were divided according to initial body weight into 7 groups. Each group was further subdivided equally according to sex. Groups 1, 2, and 3 received sodium fluoride, stannous fluoride,[†] or sodium fluorostannite[‡] respectively, at a fluoride concentration of 30 parts/million. Group 4 received sodium oxalate at an oxalate concentration of 30 parts/million. Group 5 received 1% solution of sodium N-palmitoyl sarcosinate. Group 6 received a solution of sodium N-palmitoyl sarcosinate and sodium fluoride, the concentrations of which were identical with those which were used in Groups 1 and 5 above. Group 7 received distilled water and served as control. In all instances the compounds were put in drinking water, which the animals received *ad libitum*. All solutions were made fresh each morning, and any solutions remaining in the drinking tubes from previous day were discarded. No attempt was made to regulate amount of solution the animals received. However, frequent estimates were made concerning amount

of water which an entire group drank during a 24-hour period. These data initially indicated that the 2 sarcosinate groups and the stannous fluoride groups consumed somewhat less solution, but after about 30 days these differences were not pronounced. The animals all received the same stock corn cariogenic diet[§] and were housed in pairs in raised-screen cages in air-conditioned room. The duration of the study was 140 days, after which the animals were sacrificed by ether and the heads removed for dental caries evaluation as previously described(6).

Results. A summary of the pertinent data (Table I) indicates that the 3 fluorides were the only substances tested which numerically decreased the mean number of dental cavities, when compared to the control. However, of the 3 fluorides only stannous fluoride and sodium fluorostannite were significantly effective (probability of 0.05). When sodium fluoride was added to the sarcosinate solution at the same concentration as in Group 1, no effect on dental caries was observed. The reason for the apparent difference between the 2 sodium fluoride groups, with and without sarcosinate, is not known. Sodium oxalate was without effect, while 2 groups receiving sodium N-palmitoyl sarcosinate had an apparent but not significant increase in incidence of dental caries.

In both groups receiving the sarcosinate solution there was less weight gain during the

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[†] Obtained from Metal and Thermit Co., Rahway, N. J.

[‡] Synthesized in Department of Chemistry at Indiana University.

[§] Composition of diet was as follows: yellow corn grits, 52.7%; ground yellow whole corn, 11.3%; powdered whole milk, 30%; alfalfa, 4.8%; iodized sodium chloride, 1%; and irradiated yeast, .2%.

TABLE I. Comparison of Ability of Potential Anticariogenic Substances to Reduce Incidence of Dental Caries in the Rat.

Group	No. of animals	Dental caries experience		
		Mean No. of lesions	Molars affected	% change*
Sodium fluoride	32	8.0 $\pm$ 1.4†	3.7	- 17
Stannous fluoride	30	7.1 $\pm$ 1.1	3.5	- 26
Sodium fluorostannite	32	6.8 $\pm$ 1.0	3.5	- 29
Sodium oxalate	29	9.8 $\pm$ 1.8	4.7	+ 7
Sodium N-palmitoyl sarcosinate	29	10.7 $\pm$ 2.0	5.5	+ 15
<i>Idem</i> + sodium fluoride	34	10.3 $\pm$ 1.6	4.8	+ 12
Control	30	9.6 $\pm$ 1.5	4.5	—

* Based upon comparison between mean No. of lesions in control and various groups.

† Stand. dev.

experiment than in the control group. In the group receiving sarcosinate solution, the final weight of males was 284 g. of females 206 g. as compared to 345 g and 226 g for males and females in the control group. Similarly, the male group receiving sarcosinate and sodium fluoride weighed 288 g and the females 198 g. These were the only groups which did not weigh as much as, or more than, the controls.

Table II compares our data, concerning the effect of these substances on enamel solubil-

TABLE II. Comparison between Effects of 5 Different Compounds on Powdered Enamel Solubility and on Rat Dental Caries. Correlation with human dental caries is indicated where justified on the basis of published clinical studies.

	% reduction in powdered enamel solubility*	% reduction in dental caries in rats	Effect in human clinical studies
Sodium fluoride	44	17	positive(1,3)
Stannous "	86	26	" (1,7)
Sodium fluorostannite	85	29	not available
Sodium N-palmitoyl sarcosinate	20	0	<i>Idem</i>
Sodium oxalate	1	0	"

* Previously published(8) and used here for comparative purposes only.

ity, dental caries in rats, and human caries experience. It is seen from this Table that sodium fluoride was less effective in reducing both powdered enamel solubility and rat dental caries, but was effective in reducing human dental caries. Similarly, sodium oxalate was ineffective in reducing powdered enamel solubility as well as rat dental caries, while sodium N-palmitoyl sarcosinate was only moderately effective in reducing powdered enamel solubility, and ineffective in reducing rat dental caries. It is hoped that these materials will be carefully tested with respect to their ability to reduce caries in humans, in order that the presence or absence of correlations among the several methods can eventually be established.

As judged by these experiments, the animal studies seem to predict the general usefulness of fluorides in reducing dental caries by topical procedures. If these correlations are correct they would also suggest the usefulness of sodium fluorostannite, since it also produced significantly less dental caries, but, to be valid for humans this finding on rats must be confirmed by the demonstration of reduction in human dental caries.

Much additional work is needed before anything definite can be said regarding these correlations. However, at present there appears to be a good correlation between results obtained on enamel solubility and rat dental caries.

Summary. The effectiveness of sodium fluoride, stannous fluoride, sodium fluorostannite, sodium oxalate, and sodium N-palmitoyl sarcosinate was compared in their ability to reduce experimental dental caries in the rat. Only fluorides resulted in less dental caries, while stannous fluoride and sodium fluorostannite were significantly different from controls. Sodium fluoride and sarcosinate fed together had no effect on the caries rate.

1. Howell, C. L., Gish, C. W., Smiley, R. D., and Muhler, J. C., *J.A.D.A.*, 1955, v50, 14.

2. Muhler, J. C., Radike, A. W., Nebergall, W. H., and Day, H. G., *ibid.*, 1955, v50, 163.

3. Knutson, J. W., and Armstrong, W. D., *Pub. Health Rep.*, 1943, v58, 1701.

4. Cleland, M. R., and Sanders, R. G., *J.A.D.A.*,