

ON THE BEHAVIOR OF ANTISEPTICS TOWARD SALIVARY DIGESTION.

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Among the various causes which injuriously affect public health perhaps none has received less supervision in this country than the practice of food adulteration. A systematic examination of the food commodities as found upon the market reveals a condition of affairs which is simply appalling to one interested in public welfare. The investigations on this subject show conclusively, that nearly all classes of manufactured or prepared articles of food are liable to be found adulterated.

In many cases, it is true, the adulteration is merely fraudulent and not injurious to health, but, on the other hand, a mass of evidence has accumulated to show that for the sake of gain or of advantage over a competitor, the sophisticator of human food will not shrink from employing such means as endanger the health, or even the life, of the consumer.

One class of food adulterations which has been universally employed of late, without restriction, embraces the use of antiseptics for preserving perishable articles of food. This subject is of especial interest at the present time because the practice of employing various antiseptics as food preservatives is not confined to the manufacturer and dealer, but has found its way into private households all over the land, and because the baneful effects of this practice are not fully appreciated or understood by the public. In general only such antiseptics can be employed as are devoid of an appreciable taste and odor and not immediately injurious in their action upon the consumer. Among these substances may be mentioned salicylic acid, boracic acid, borax, calcium sulphite and saccharine.

That saccharine will doubtless come into general use in food and drink may readily be inferred from its extreme sweetness and its antiseptic properties.

The market is full of preparations which contain boracic or salicylic acid or both, and which are sold as lard bleachers, sausage and meat preservatives, fruit, cider and wine preservatives, &c.

A few of these articles, which the writer has examined, may be mentioned here for the sake of illustration.

1. A lard bleacher called "snow white," containing 10.86 per cent. of boracic acid, and 47.12 per cent. borax.

2. A salt, colored pink with cochineal, called B. Savaline, and used as a sausage and meat preservative, containing 16.26 per cent. boracic acid.

3. A sample of anti-ferment for keeping cider sweet, consisting of
 Boracic acid 21.6 per cent.
 Salicylic " 78.4 "

4. Three preservative salts for meat containing respectively, 31.91, 43.05 and 53.22 per cent. boracic acid.

5. A preparation claimed to be harmless, for meats and other foods, containing :

Boracic acid.....	25 per cent.
Saltpetre.....	45 "
Salt.....	30 "

After H. Leffman and W. Beam (Analyst, Vol. 13, page 103), had shown, that certain antiseptics completely arrested the conversion of starch into grape sugar by diastase and pancreatic extract, the writer naturally inferred that a similar effect would be produced by these substances on the diastatic action of saliva.

At my suggestion, Mr. C. T. Fox, one of my students, took up the matter as a subject for his graduating thesis.

The results of his careful and painstaking work are embodied in part in the following tables.

The method employed was as follows :

1 gram of starch was mixed with 10 c. c. of water, and boiled five minutes; 5 c. c. more of water was added, the liquid was cooled to 40° C., 5 c. c. saliva of the same temperature was added, the mixture was violently shaken and kept at the temperature of 40° C. for the required time, when the action of the saliva was suddenly stopped by heating to the boiling point. The mixture was then neutralized, diluted to 100 c. c. and the sugar was de-

terminated by Fehling's solution. At each step parallel tests were made with one gram of pure starch and with one gram of starch containing the indicated amount of preservative, using equal amounts of the same saliva in each case. The preservatives employed were: salicylic acid, boracic acid, calcium sulphite and saccharine.

In the subjoined tables of results (a) represents the amount of sugar obtained from the pure starch, and (b) that obtained from the starch mixed with the varying amounts of the preservatives.

In each step the starch was subjected to the action of the saliva for different lengths of time, viz: 1, 5, 15, 30 and 60 minutes.

TABLE I.

Starch	100 grams.
Salicylic acid	1 gram.
1 part preservative to 2,100 parts food.	
Time, 1 minute; grape sugar	{ a. 7.75 per cent. b. 9.61 "
Time, 5 minutes; grape sugar	{ a. 9.61 " b. 10.80 "
Time, 15 minutes; grape sugar	{ a. 22.77 " b. 20.83 "
Time, 30 minutes; grape sugar	{ a. 26.31 " b. 27.77 "
Time, 1 hour; grape sugar	{ a. 27.67 " b. 33.33 "

TABLE II.

Starch	100 grams.
Borax	1 gram.
1 part preservative to 2,100 parts food.	
Time, 1 minute; grape sugar	{ a. 12.82 per cent. b. 9.10 "
Time, 5 minutes; grape sugar	{ a. 20.83 " b. 14.70 "
Time, 15 minutes; grape sugar	{ a. 28.15 " b. 13.51 "
Time, 30 minutes; grape sugar	{ a. 25.00 " b. 16.66 "
Time, 1 hour; grape sugar	{ a. 35.04 " b. 27.38 "

TABLE III.

Starch	100 grams.
Calcium sulphite	1 gram.
1 part preservative to 2,100 parts food.	
Time, 1 minute; grape sugar	{ a. 12.82 per cent. b. 14.70 "
Time, 5 minutes; grape sugar	{ a. 20.83 " b. 17.86 "
Time, 15 minutes; grape sugar	{ a. 28.15 " b. 22.56 "
Time, 30 minutes; grape sugar	{ a. 25.00 " b. 29.83 "
Time, 1 hour; grape sugar	{ a. b.

TABLE IV.

Starch	100 grams.
Saccharine	1 gram.
1 part preservative to 2,100 parts food.	
Time, 1 minute; grape sugar	{ a. 12.82 per cent. b. 19.20 "
Time, 5 minutes; grape sugar	{ a. 20.83 " b. 30.06 "
Time, 15 minutes; grape sugar	{ a. 28.15 " b. 25.51 "
Time, 30 minutes; grape sugar	{ a. 25.00 " b. 23.80 "
Time, 1 hour; grape sugar	{ a. 35.04 " b. 25.51 "

TABLE V.

Starch	50 grams.
Salicylic acid	1 gram.
1 part preservative to 1,050 parts food.	
Time, 1 minute; grape sugar	{ a. 10.62 per cent. b. 10.86 "
Time, 5 minutes; grape sugar	{ a. 33.83 " b. 27.70 "
Time, 15 minutes; grape sugar	{ a. 33.01 " b. 38.40 "

TABLE V.—*Continued.*

Time, 30 minutes; grape sugar.....	}	a. 34.48	per cent.
		b. 34.48	“
Time, 1 hour; grape sugar.....	}	a. 41.66	“
		b. 41.66	“

TABLE VI.

Starch	50 grams.		
Borax	1 gram.		
1 part preservative to 1,050 parts food.			
Time, 1 minute; grape sugar.....	}	a. 10.62	per cent.
		b. 13.90	“
Time, 5 minutes; grape sugar.....	}	a. 33.33	“
		b. 14.28	“
Time, 15 minutes; grape sugar.....	}	a. 33.01	“
		b. 18.51	“
Time, 30 minutes; grape sugar.....	}	a. 34.48	“
		b. 27.77	“
Time, 1 hour; grape sugar.....	}	a. 41.66	“
		b. 29.41	“

TABLE VII.

Starch	50 grams.		
Calcium sulphite.....	1 gram.		
1 part preservative to 1,050 parts food.			
Time, 1 minute; grape sugar.....	}	a. 10.62	per cent.
		b. 10.41	“
Time, 5 minutes; grape sugar.....	}	a. 33.33	“
		b. 28.40	“
Time, 15 minutes; grape sugar.....	}	a. 33.01	“
		b. 26.29	“
Time, 30 minutes; grape sugar.....	}	a. 34.48	“
		b. 38.46	“
Time, 1 hour; grape sugar.....	}	a. 41.66	“
		b. 30.71	“

TABLE VIII.

Starch	50 grams.
Saccharine.....	1 gram.
1 part preservative to 1,050 parts food.	
Time, 1 minute; grape sugar.....	{ a. 10.62 per cent. b. 12.50 “
Time, 5 minutes grape sugar	{ a. 33.33 “ b. 35.71 “
Time, 15 minutes; grape sugar.....	{ a. 33.01 “ b. 35.71 “
Time, 30 minutes; grape sugar	{ a. 34.48 “ b. 34.40 “
Time, 1 hour; grape sugar.....	{ a. 41.66 “ b. 40.32 “

TABLE IX.

Starch	40 grams.
Salicylic acid.....	1 gram.
1 part preservative to 840 parts food.	
Time, 1 minute; grape sugar.....	{ a. 16.66 per cent. b. 2.84 “
Time, 5 minutes; grape sugar	{ a. 20.00 “ b. 3.52 “
Time, 15 minutes; grape sugar.....	{ a. 26.31 “ b. 14.28 “
Time, 30 minutes; grape sugar	{ a. 31.25 “ b. 23.80 “
Time, 1 hour; grape sugar.....	{ a. 38.45 “ b. 35.71 “

TABLE X.

Starch.....	40 grams.
Borax.....	1 gram.
1 part preservative to 840 parts food.	
Time, 1 minute; grape sugar.....	{ a. 16.66 per cent. b. 4.46 “
Time, 5 minutes; grape sugar	{ a. 20.00 “ b. 8.33 “

TABLE X.—*Continued.*

Time, 15 minutes; grape sugar.....	{ a. 26.31 per cent.
	{ b. 19.22 “
Time, 30 minutes; grape sugar.....	{ a. 31.25 “
	{ b. 27.27 “
Time, 1 hour; grape sugar.....	{ a. 38.45 “
	{ b. 33.34 “

TABLE XI.

Starch.....	40 grams.
Calcium sulphite.....	1 gram.
1 part preservative to 840 parts food.	
Time, 1 minute; grape sugar.....	{ a. 16.66 per cent.
	{ b. 12.19 “
Time, 5 minutes; grape sugar.....	{ a. 20.00 “
	{ b. 22.72 “
Time, 15 minutes; grape sugar.....	{ a. 26.37 “
	{ b. 29.35 “
Time, 30 minutes; grape sugar.....	{ a. 37.25 “
	{ b. 33.33 “
Time, 1 hour; grape sugar.....	{ a. 38.45 “
	{ b. 38.40 “

TABLE XII.

Starch.....	40 grams.
Saccharine.....	1 gram.
1 part preservative to 840 parts food.	
Time, 1 minute; grape sugar.....	{ a. 16.66 per cent.
	{ b. 22.72 “
Time, 5 minutes; grape sugar.....	{ a. 20.00 “
	{ b. 29.41 “
Time, 15 minutes; grape sugar.....	{ a. 36.31 “
	{ b. 35.71 “
Time, 30 minutes; grape sugar.....	{ a. 31.25 “
	{ b. 35.71 “
Time, 1 hour; grape sugar.....	{ a. 38.45 “
	{ b. 41.66 “

TABLE XIII.

Starch	20 grams.
Salicylic acid	1 gram.
1 part preservative to 420 parts food.	
Time, 1 minute; grape sugar	{ a. 7.14 per cent. b. None.
Time, 5 minutes; grape sugar	{ a. 20.83 " b. None.
Time, 15 minutes; grape sugar	{ a. 26.31 " b. None.
Time, 30 minutes; grape sugar	{ a. 30.00 " b. None.
Time, 1 hour; grape sugar	{ a. 36.76 " b. None.

TABLE XIV.

Starch	20 grams.
Borax	1 gram.
1 part preservative to 420 parts food.	
Time, 1 minute; grape sugar	{ a. 7.14 per cent. b. Trace.
Time, 5 minutes; grape sugar	{ a. 20.83 " b. 10.00 "
Time, 15 minutes; grape sugar	{ a. 26.31 " b. 13.88 "
Time, 30 minutes; grape sugar	{ a. 30.00 " b. 29.23 "
Time, 1 hour; grape sugar	{ a. 36.76 " b. 31.22 "

TABLE XV.

Starch	40 grams.
Calcium sulphite	1 gram.
1 part preservative to 420 parts food.	
Time, 1 minute; grape sugar	{ a. 7.14 per cent. b. 7.81 "
Time, 5 minutes; grape sugar	{ a. 20.83 " b. 28.73 "

TABLE XV.—*Continued.*

Time, 15 minutes; grape sugar.....	{ a. 26.31 per cent.
	{ b. 27.78 “
Time, 30 minutes; grape sugar.....	{ a. 30.00 “
	{ b. 35.71 “
Time, 1 hour; grape sugar.....	{ a. 36.76 “
	{ b. 35.71 “

TABLE XVI.

Starch.....	20 grams.
Saccharine.....	1 gram.
1 part preservative to 420 parts food.	
Time, 1 minute; grape sugar.....	{ a. 7.14 per cent.
	{ b. None.
Time, 5 minutes; grape sugar.....	{ a. 20.83 “
	{ b. None.
Time, 15 minutes; grape sugar.....	{ a. 26.31 “
	{ b. None.
Time, 30 minutes; grape sugar.....	{ a. 30.00 “
	{ b. None.
Time, 1 hour; grape sugar.....	{ a. 36.76 “
	{ b. None.

TABLE XVII.

Starch.....	10 grams.
Salicylic acid.....	1 gram.
1 part preservative to 210 parts food.	
Time, 1 minute; grape sugar.....	{ a. 19.83 per cent.
	{ b. None.
Time, 5 minutes; grape sugar.....	{ a. 12.82 “
	{ b. None.
Time, 15 minutes; grape sugar.....	{ a. 21.30 “
	{ b. None.
Time, 30 minutes; grape sugar.....	{ a. 33.35 “
	{ b. None.
Time, 1 hour; grape sugar.....	{ a. 38.45 “
	{ b. None.

TABLE XVIII.

Starch.....	10 grams.
Borax.....	1 gram.
1 part preservative to 210 parts food.	
Time, 1 minute; grape sugar.....	{ a. 19.83 per cent. b. None.
Time, 5 minutes; grape sugar.....	{ a. 12.82 per cent. b. Trace.
Time, 15 minutes; grape sugar.....	{ a. 21.30 per cent. b. 8.92 “ “
Time, 30 minutes; grape sugar.....	{ a. 33.35 per cent. b. 17.85 “ “
Time, 1 hour; grape sugar.....	{ a. 38.45 “ “ b. 29.41 “ “

TABLE XIX.

Starch.....	10 grams.
Calcium sulphite.....	1 gram.
1 part preservative to 210 parts food.	
Time, 1 minute; grape sugar.....	{ a. 19.83 per cent. b. Trace.
Time, 5 minutes; grape sugar.....	{ a. 12.82 per cent. b. Trace.
Time, 15 minutes; grape sugar.....	{ a. 21.30 per cent. b. 22.72 “ “
Time, 30 minutes; grape sugar.....	{ a. 33.35 “ “ b. 31.25 “ “
Time, 1 hour; grape sugar.....	{ a. 38.45 “ “ b. 31.25 “ “

TABLE XX.

Starch.....	10 grams.
Saccharine.....	1 gram.
1 part preservative to 210 parts food.	
Time, 1 minute; grape sugar.....	{ a. 19.83 per cent. b. None.
Time, 5 minutes; grape sugar.....	{ a. 12.82 per cent. b. None.

TABLE XX.—*Continued.*

Time, 15 minutes; grape sugar.....	{ a. 21.30 per cent. b. None.
Time, 30 minutes; grape sugar.....	{ a. 33.35 per cent. b. None.
Time, 1 hour; grape sugar.....	{ a. 38.45 per cent. b. None.

From the inspection of the tables it will be seen, that when the preservatives were present in the proportion of one part to 210 parts of the food mixture the diastatic action of the saliva was completely arrested, *in each case* for the periods of one minute and five minutes. For the other periods of time the calcium sulphite was without effect, borax retarded the action to the end, while in the case of salicylic acid and saccharine not a trace of sugar was formed even in the one hour period.

When the amount of the preservatives employed equalled 1 part to 420 parts of the food mixture not a trace of sugar was formed, even in the one hour period, in the case of salicylic acid and saccharine. Borax completely arrested the diastatic action for the remaining periods up to the hour period. In this proportion calcium sulphite was without effect.

Where the proportion of the preservative was 1 to 840 parts of the food mixture, salicylic acid almost stopped the action of saliva for the periods of one and five minutes and appreciably retarded it for the remaining periods. Borax had a very depressing effect for the one, five and fifteen minutes periods with less marked results in the thirty and sixty minutes periods. Calcium sulphite and saccharine were without effect.

Where the proportion was one of preservative to 1050 of food mixture borax alone showed a depressing effect. The results with borax are also shown to be similar to the last, when the preservative present amounted to only 1 part in 2100 parts of the food mixture.