quantity of formalin is too small to produce as vigorous an action as in the other cases.

In Experiment X the proportion of permanganate was increased, with the result that the amount of formaldehyde sent out into the bottle was not affected much, but considerably less remained with the residue.

In Experiment XI the permanganate was decreased to the ratio used by Evans (Maine Board of Health) in the report on his method. The result shows a considerable decrease in the formaldehyde sent out into the bottle and large increase in the amount remaining in the residue.

EXPERIMENTS WITH DILUTED FORMALIN AND PERMANGANATE.

Two experiments were made with 0.6 cc. formalin diluted with 0.3 cc. water and 0.375 gram of powdered permanganate, which are the same proportions as used in most of the experiments in Table II. The procedure was the same as described above.

TABLE VII.

	Date.	Formaldehyde found in bottle. Per cent.	Formaldehyde found in residue. Per cent.	Total found. Per cent.
I.	8/23, 1905.....	31.00	34.23	65.23
II.	8/23, 1905.....	32.16	34.04	66.20

The percentage yield was about the same as that given in Table II, but less than that in the previous experiments (Table VI) with undiluted formalin. The formaldehyde remaining with the residue was about the same as in the previous experiments where powdered permanganate was used. The total formaldehyde found was less than in the experiments with undiluted formalin, indicating a greater destruction of formaldehyde.

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THE AMOUNT OF SODIUM SULPHITE RECOVERABLE FROM FOOD PRODUCTS AS A BASIS FOR THE ESTIMATION OF THE AMOUNT ORIGINALLY PRESENT.

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AT A time when so many misleading statements are being made concerning sodium sulphite and sulphurous acid as food pre-

servatives and the amounts actually used in the preservation of meats and the bleaching of fruits, it is necessary in order to form an impartial judgment, to make a careful investigation of products actually offered for sale and especially those products which are used extensively. This paper embodies the results obtained by the writer in the Food Laboratory of the North Dakota Experiment Station.

Writers who advocate the use of preservatives would have us believe that sodium sulphite is always used in very small quantities. Dr. Calm, in his treatise on "Sulphurous Acid and Sulphites as Food Preservatives," when discussing the statement that sodium sulphite confers upon minced meat an abnormally brilliant red color, says, "this is not true of the very small amounts of sodium sulphite actually employed on meat, *e. g.*, 0.075 per cent." Again, further on in the same article he repeats this statement adding that 76 to 96 per cent. of this is oxidized to sulphate before the meat is eaten, and from the remaining per cent. of sulphurous acid, the amount naturally present in meat (0.0047-0.01 per cent.) must be deducted, the moiety of free sulphurous acid left in meat preserved by sulphites, is rather startling to those who claim that sodium sulphite as a food preservative is deleterious to health.

In order to determine the accuracy of these statements the following experiments were carried out. The sodium sulphite was added to freshly prepared pork sausage and determinations of the amounts recovered, calculated from the sulphurous acid distilled over, were made, after allowing the meat to stand for the various lengths of time.

TABLE I.—AMOUNTS OF SODIUM SULPHITE RECOVERED.

100 grams pork sausage mixed with 0.2 per cent. sodium sulphite.	After 6 hours.	After 24 hours.	After 36 hours.	After 3 days.
I	49.75	32.43	23.06	23.28
II	26.15	30.85	25.10	22.81
III	33.15	31.75	24.16	22.11
IV	....	....	....	22.45
Average	36.35	31.68	24.11	22.66

Out of forty-three samples of pork sausage and Hamburg steak collected at different butcher shops throughout the state by

E. F. Ladd, Food Commissioner, thirty contained sulphites; of this number, eighteen were examined quantitatively and the following amounts of sodium sulphite, calculated from the sulphurous acid, were recovered. All of the samples were at least thirty-six hours old when analyzed and the majority of them were considerably older, as they had developed the odor of standing meat. Assuming from the above data that as much as one-fourth of the sodium sulphite was recovered, which is stating it very conservatively, the minimum per cent. originally present is given in the last column of the following table.

TABLE II.

100 grams of the samples were treated with phosphoric acid in the usual manner. Lab. No.	Amount of sodium sulphite recovered. Grams.	Minimum. per cent. originally present.
2634, Pork Sausage	0.1315	0.53
2635, Sausage Meat	0.356	1.42
2636, Hamburg Steak	0.3515	1.41
2637, Sausage Meat	0.0294	0.37
2638, Hamburg Steak	0.131	0.52
2648, Sausage Meat	0.0494	0.20
2649, Sausage Meat	0.1206	0.48
2651, Sausage Meat	0.361	1.44
2652, Sausage Meat	0.0356	0.14
2681, Sausage Meat	0.0951	0.38
2683, Sausage Meat	0.0931	0.37
2691, Sausage Meat	0.0894	0.36
2707, Sausage Meat	0.137	0.45
2708, Sausage Meat	0.054	0.22
2710, Sausage Meat	0.0758	0.30
2711, Sausage Meat	0.023	0.09
2734, Sausage Meat	0.044	0.18
2737, Sausage Meat	0.0385	0.15
Average	0.1265	0.50

In order to ascertain the amount recoverable when varying amounts of sodium sulphite were used with the same quantity of sausage, the following experiments were carried out. The meat stood four days after being treated with the sulphite. The distillates were collected in two portions.

TABLE III.

100 grams meat used.	Per cent. first distillate 50 cc.	Per cent. second distillate 100 cc.	Total per cent. recovered.
I 0.2 gram sodium sulphite.....	16.94	6.07	23.01
II 0.3 gram sodium sulphite.....	11.81	6.90	18.71
III 0.4 gram sodium sulphite.....	18.98	3.56	22.54
IV 0.5 gram sodium sulphite.....	17.90	4.85	22.75
Average.....	16.41	5.35	21.75

Several portions of pork sausage were mixed with 0.2 per cent. of sodium sulphite and after standing twenty-four and thirty-six hours were fried in the usual manner and then distilled with phosphoric acid and the sodium sulphite calculated from the sulphurous acid, as usual.

TABLE IV.

Weight of meat, 100 grams.	After 24 hours.	After 36 hours.
I.....	27.72	20.81
II.....	27.08	20.70
III.....	28.22	20.28
Average.....	27.67	20.70

Table IV shows that very nearly as much sodium sulphite is recovered from the fried sausage as from that which has been subjected to the process of distillation only. It is very evident from a study of Table II that surprisingly large amounts of unoxidized sulphite are liable to be taken into the system. For example from laboratory numbers 2635, 2636 and 2651, 0.356 gram, 0.3515 gram and 0.361 gram of sodium sulphite were recovered from 100 grams of meat. Eighty grams of sausage would be easily eaten by an ordinary adult at a meal; this would mean about 0.3 gram of unoxidized sulphite taken into the system in the above instances, along with 1.0 gram, approximately, of sodium sulphate.

ESTIMATION OF COMBINED SULPHUROUS ACID IN DRIED AND EVAPORATED FRUITS.

Fourteen samples of dried or evaporated fruits offered for sale in this state were examined quantitatively for the amount of combined sulphurous acid present. The amount recovered, calculated as sodium sulphite, being given in the following table:

TABLE V.

Lab. No.	Amount of fruit used, 100 grams.	Amount recovered.
2604	Ruby Prunes	0.042
2607	Evaporated Apricots	0.165
2608	Evaporated Peaches	0.115
2617	Evaporated Peaches	0.112
2619	Ruby Prunes	0.190
2620	Dried Apricots	0.149
2640	Silver Prunes	0.046
2653	Silver Prunes	0.086
2666	Silver Prunes	0.110
2685	Silver Prunes	0.226
2730	Ruby Prunes	0.141
2731	Ruby Prunes	0.174
2732	Silver Prunes	0.123
2787	Ruby Prunes	0.054
	Average	0.124

The average amount of combined sulphurous acid calculated as sodium sulphite in the above analyses, approximates very closely that found in the preserved meats and is sufficient to condemn these fruits as an article of diet, when we consider that the amount recovered probably represents only a fraction of the amount originally present.

CONCLUSIONS.

(1) The amount of sulphites mixed with meats to preserve them is much larger than is generally supposed.

(2) The amount of sulphites recovered is approximately one-fourth the amount originally present.

(3) The amount of unoxidized sulphites in fried meats (sausage) is much larger than several writers would have us to believe.

(4) With dried fruits which have been bleached with sulphurous acid, free or combined, the amount remaining unoxidized in the fruit is large, averaging 0.124 per cent. in the above samples. In one instance as much as 0.226 per cent. was recovered, calculated as sodium sulphite.

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