SCIENTIFIC APPARATUS AND LABORATORY METHODS

COMPOUNDS FOR CONTROL OF ORANGE DECAYS

DECAYS of fruits, caused either by the stem-end rot organisms, *Phomopsis citri* and *Diplodia natalensis*, or the green and blue mold organisms, *Penicillium digitatum* and *Penicillium italicum*, have resulted in serious economic losses. Investigations on control measures have been carried on intensively over a long period by the U. S. Department of Agriculture Subtropical Fruit Field Station, Orlando, Fla. Recently a brief report[1] was made on the striking effectiveness of thiourea in controlling these diseases. The amounts of thiourea possible of ingestion from treated fruits is much below the lowest dose mentioned in any toxicity studies, but treatment of fruits with this material can not be recommended until prolonged feeding tests have been completed. Consequently, a search has been made for less objectionable compounds of equal effectiveness.

Compounds for testing were selected in part on the basis of structural similarity to thiourea and in part on the basis of reports of promising materials by other workers.[3, 5]

Of twenty-five materials recently tested, thioacetamide, 8-hydroxy=quinoline sulfate and 2-aminothiazole gave good to excellent control of decays. The results obtained with those concentrations found most effective are presented in Table 1.

TABLE 1

CONTROL OF ORANGE DECAYS

Treatment	No. of experiments	No. fruits treated	Decays		
			No. stem-ends	No. penicillium	Per cent. decay
Thioacetamide, 5 per cent. ..	5	232	2	2	1.7
Check	5	231	46	30	32.9
8-Hydroxyquinoline sulfate 5 per cent.	2	86	0	9	10.5
Check	2	86	18	10	32.6
2-Aminothiazole, 5 per cent. (110° F.)	2	80	2	4	7.5
Check	2	83	31	4	42.2

In the experimental treatments oranges were dipped from 2 to 5 seconds in water solutions. Each lot consisted of approximately 40 fruits. Several varieties were used, and in most experiments the fruits had been previously exposed to ethylene gas to predispose them to rapid stem-end decay. After treatment the fruits were held at 70° F. for several weeks before examination.

The explanation for the effectiveness of three of the materials found to date may lie in certain similarities of chemical structure. It appears that the presence of both an amino group and sulfur is essential for fungicidal activity in these compounds. Thiourea, previously reported on, is effective, while urea is ineffective. Both compounds carry amino groups, but the effective one carries in addition divalent sulfur. Thioacetamide (Table 1) is effective, while thioacetic acid is not. In this case both compounds carry sulfur, but the effective one carries in addition an amino group. The compound 2-aminothiazole also satisfies this criterion and is effective (Table 1). Thiourea in water solution is reported to tautomerize to the thiol form;[4] if so, it is probable that thioacetamide and 2-aminothiazole do likewise. Cristol *et al.*[2] maintain, however, that the thiol form does not exist in neutral aqueous solution and that $S=C(NH_2)$ and $HN=C(NH_2)$ are the only possible forms. It is not possible at this time to state whether the toxicity noted in these thio-amino compounds is due to the presence of a thiol form or a ring form.

To the best of our knowledge the compounds studied may also require considerable toxicity investigation before they can be accepted for use in the treatment of fruits. Since, however, they are effective and since it is possible that their toxicity may be of such order that they would be preferable to thiourea, we feel the data concerning their effectiveness should be presented for consideration by those interested in this problem.

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2 P. Cristol, R. Seigneurin and J. Fourcade, *Compt. Rend.*, 200: 2223–5, 1935; *Chem. Abst.*, 29: 7159–9, 1935.

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THE ELECTRONIC BLANCHING OF VEGETABLES[1]

FOR their successful preservation by freezing or dehydration, vegetables are briefly exposed to flowing steam or boiling water. This heat treatment results in the inactivation of enzymes which may be respon-

1 Journal Paper No. 637, of the New York State Agricultural Experiment Station, Cornell University, Geneva, N. Y., June 4, 1945.

sible for the deterioration of flavor and destruction of ascorbic acid and carotene during storage. The use of these heating agencies, however, often damages the texture of the vegetable, making them undesirably soft. Moreover, the steam or boiling water leaches out vitamin C and members of the vitamin B complex from these foodstuffs.

It has occurred to us that if electronic heat could be employed in lieu of steam or boiling water, the texture might be improved and losses in vitamin content due to leaching greatly reduced, if not eliminated. Further, through the use of high frequency electricity it was thought possible to place the washed fresh vegetables in the final retail cartons, pass them through a high frequency field for enzyme inactivation and thence into the freezer. Such a procedure should eliminate much handling and possible attendant contamination of the vegetable before it reached the consumer in the frozen state.

In preliminary experiments frequencies of 7 to 10 and 28 to 29 megacycles were used, but the application of sufficient r.f. power to cause the rapid heating of peas, diced carrots and diced potatoes resulted in arcing between the electrodes and any projecting vegetable tissue. There was also burning between individual pieces, although the tendency to arcing or flashover was less at the higher frequency. Recourse was then made to a frequency of 150 megacycles. Experiments conducted on the heating of cabbage with an oscillator[2] having an output of 750 watts at this high frequency have shown that there is little tendency to arc if the vegetable is tightly packed into the container. In testing the effectiveness of dielectric heating, heads of cabbage were cut into slices an eighth of an inch thick and the shredded material packed into Peters-type cartons commonly used in the freezing of vegetables. A carton of shredded cabbage was placed between two copper electrodes mounted in an electric air oven. Tuning stubs were attached to the electrodes to eliminate standing waves[3] and assist in coupling the load to the oscillator. An oven temperature of 100° C. was used to prevent the condensation of moisture on the electrodes and counteract heat losses from the carton by radiation. A heating period of two to three minutes was sufficient to raise the temperature of 180 grams of cabbage to 99° C., as indicated by a spirit-filled thermometer inserted in the carton.

As an indication of the small nutrient losses that may be expected in blanching with r.f. power, the ascorbic acid contents of raw and of water, steam and electronically blanched cabbage samples were determined. The blanching periods were in each case of minimal duration to insure a negative catalase test. The results are presented in Table 1.

TABLE 1

LOSS OF ASCORBIC ACID DURING BLANCHING BY BOILING WATER, STEAM AND R.F. POWER

Sample	Blanching time in minutes	Ascorbic acid content mg/gm	Per cent. loss on blanching
Raw I		0.38	
Steam blanched	2.5	0.26	32
Water blanched	0.75	0.23	40
Raw II		0.34	
Electronically blanched	2.5	0.33	3

The same lot of shredded cabbage was used for all three blanching operations, and 35-gram portions were taken for analyses to insure adequate sampling. The water and steam treatments were carried on simultaneously, hence only a single analysis of the raw product sufficed as a reference. Since the electronic blanching was performed an hour later and raw shredded cabbage loses ascorbic acid on standing, a second raw sample was analyzed immediately prior to r.f. application.

The nearly negligible loss of ascorbic acid during electronic blanching in contrast to the 30 to 40 per cent. losses occurring in the steam and water processes points the way to production of processed vegetables of higher nutritive value. Other vegetables have been successfully blanched by electronics, and more extensive studies of the value of dielectric heating for the inactivation of enzymes in fruit and vegetables are in progress and will include storage trials.

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DISCUSSION

FAGARINE, A POSSIBLE SUBSTITUTE FOR QUINIDINE

THE present difficulty of obtaining quinidine in quantity has prompted us to send the following information on α-fagarine, which has cardiac effects similar to those of quinidine leading us to believe that it might be employed as a substitute and, more important, that it might open the way for the prepara-

[2] We are indebted to R.C.A. for the loan of the oscillator and to Dr. G. H. Brown and Mr. R. A. Bierwirth, of the R.C.A. Laboratories, Princeton, N. J., for their help in the arrangement of the tuning circuit.

[3] R. A. Bierwirth and C. N. Hoyler, *Proc. Inst. Radio Engrs.*, 31: 529–536, 1943.