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SHORT COMMUNICATION

HEXANOL AND HEXYL ACETATE AND SOFT SCALD OF APPLES

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Abstract—Jonathan apples which had been injected with hexanol or hexyl acetate during cool storage had a higher level of soft scald than control fruit. Twenty other compounds had no effect on the level of the disorder.

INTRODUCTION

SOFT (OR DEEP) scald is an important physiological disorder of cool stored apples. In affected fruit, patches of skin and the underlying flesh become brown. However, there is a remarkably clear demarcation between the brown skin or flesh and unaffected tissue, which is characteristic of the disorder.[1]

In 1924, Plagge and Maney[2] found that soft scald was due to storage at too low a temperature. Kidd and West[3] suggested in 1925 that soft scald was a similar disorder to low-temperature breakdown because both were severe at a storage temperature of 0°, whereas their incidence was only slight at 2°. In the intervening years no progress has been made in the search for the cause of soft scald, and consequently the metabolic changes associated with development of the disorder are unknown.

Recently, Wills[4] studied the volatiles given off by Jonathan apples. He found that fruit with a reduced susceptibility to low-temperature breakdown gave off more butyl, isopentyl and hexyl acetates and less of the corresponding alcohols than fruit with a higher susceptibility. Wills, Scott and McGlasson[5] found that decreased levels of acetic acid in the fruit were also associated with the control of low-temperature breakdown and that injection of acetic acid induced low-temperature breakdown.

This paper reports a study of soft scald in Jonathan apples in which substances found to be associated with low-temperature breakdown, and some other metabolites of apples, were

[1] J. BARKER, *Wastage in Imported Fruit; its Nature, Extent and Prevention*, G. Brit. Dep. Sci. Ind. Res. Food Invest. Spec. Rept. No. 38 (1938).
[2] H. H. PLAGGE and T. J. MANEY, *Apple Storage Investigations. I. Jonathan-Spot and Soft-Scald. II. Apple-Scald and Internal Breakdown*, Iowa State Coll. Agr. Exp. Sta. Bull. No. 222 (1924).
[3] F. KIDD and C. WEST, *Functional Diseases of Apples in Cold Storage*, G. Brit. Dep. Sci. Ind. Res. Food Invest. Spec. Rept No. 23 (1925).
[4] R. B. H. WILLS, *J. Sci. Food Agr.* **19**, 354 (1968).
[5] R. B. H. WILLS, K. J. SCOTT and W. B. MCGLASSON, *J. Sci. Food Agr.*, in press.

injected into the core cavity of the apples. After storage for 1 week at −1°, the fruit were injected with 0·2 ml of an aqueous or ethanolic solution containing 80 μmoles of one of the compounds listed in Table 1. All fruit were examined for soft scald after a further 10 weeks at −1°.

TABLE 1. INCIDENCE OF SOFT SCALD IN JONATHAN APPLES INJECTED WITH VARIOUS CHEMICALS

Compound	Affected (%)
Hexyl acetate*	66
Hexanol*	65
Nil	3
Water†	5
Ethanol*	1
Butanol*	0
Isopentanol*	0
Butyl acetate*	0
Isopentyl acetate*	0
Ethyl butyrate*	0
Formic acid†	5
Acetic acid†	6
Propionic acid†	3
Butyric acid†	2
Acetaldehyde†	6
cis-Oxalacetic acid†	2
L-Malic acid†	4
Malonic acid†	2
Pyruvic acid†	3
Acetoacetic acid†	3
L-Glutamic acid†	4
L-Serine†	3
R-Mevalonic acid†	0

Each value is the mean of 100 fruit (4 replicates × 25 fruit).
* Injected in ethanolic solution.
† Injected in aqueous solution.

RESULTS AND DISCUSSION

The results are shown in Table 1. The injection of hexanol or hexyl acetate, while not affecting the cortex, induced a browning of areas of the skin and underlying flesh that was identical in appearance with typical soft scald. The injection of acetic acid and other metabolites did not increase the incidence of soft scald. It is suggested that hexanol and hexyl acetate may be involved in a metabolic process which produces deep scald symptoms. The failure of acetic acid to produce soft scald further suggests that soft scald and low-temperature breakdown are produced via different metabolic disturbances.