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Discoloration of Processed Peaches as Influenced by SADH and Ethephon[1]

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Abstract. **The color of the cheek and USDA color score of processed fruit of peach (*Prunus persica* (L.) Batsch. cv. Redskin) were significantly higher when succinic acid-2,2-dimethylhydrazide (SADH) was used alone or in combination with (2-chloroethyl)phosphonic acid (ethephon). Both compounds and the combination strikingly reduced pit cavity discoloration.**

Color, an important factor in determining the USDA grade of canned peaches, and flavor are impaired by high levels of polyphenolic compounds (6). The action of polyphenoloxidase (PPO) on polyphenolic substrates has been implicated in the discoloration of canned peaches before and during processing (8, 9).

The enzymatic oxidative browning observed in fruits and catalyzed by PPO requires 3 reactants: oxygen, the enzyme, and its substrate (9). Polyphenols can also undergo a non-enzymatic polymerization and the polymeric substance, formed either enzymatically or non-enzymatically, can undergo further polymerization, especially at high storage temperatures, to form colored compounds (4, 7).

Several growth regulants have been used to advance maturity, give a more uniformly mature crop, chemically thin fruit or enhance fruit color (1, 10, 11, 12, 14). Other work suggests that SADH and ethephon effect a decrease in PPO activity and tannin content (2, 5). We attempted to determine whether the effects of these growth regulants on PPO activity and tannin content are reflected in the color of processed peaches.

In the spring of 1974 an experiment was begun to determine the effects of the growth regulants SADH and ethephon on color of processed peaches. We chose the 'Redskin' cultivar because it usually discolors when canned. The trees were selected for uniform fruit set and vigor. The treatments were the control, SADH (1500 ppm) applied at the onset of stage II, ethephon (75 ppm) applied at the onset of stage III. Each treatment was applied at random to 5 single-tree plots. The color attributes of concern were USDA color score (13) and Hunter a_L (3) of the cheek, and Hunter L and a visual rating of the pit cavity.

Individual trees were once-over harvested when about 5% of the fruit had abscissed. The fruit were divided into 2 firmness categories (2.7–5.5 kg and 5.6–8.2 kg) by measuring firmness of individual fruit on a pared surface opposite the suture with a Magness-Taylor pressure tester (0.79 cm diam plunger). The peaches were processed on an overhead lye spray peeler, covered with a 35° Brix syrup after filling into cans, exhausted 5 min, and sterilized in a spin cooker for 7 min. Each firmness category was represented by 3 cans and measurements were made on 8 halves per can. Thus, the experiment consisted of 4 growth regulator treatments, 2 firmness categories per treatment, 5 replications, 3 cans per replication and 8 halves per can, for a total of 960 observed halves.

The color of the processed halves was determined with a Hunter Color Difference Meter, model D25DM[3], with a 5 cm (2-inch) specimen port. The instrument was calibrated (yellow porcelain standard plate; L = 82.9; a_L = −5.0; b_L = 25.3) with a clear glass cover slip in place to protect the photoreceptors. We determined the Hunter a_L value of the cheek of each half and the L value of the pit cavity. In addition, a USDA color score (13) was assigned each half on the basis of cheek color. A visual rating of each pit cavity was made on a 0 to 5 scale, 5 representing no discoloration.

In all treatment combinations but one, the mean Hunter a_L value of the cheek was significantly higher for the 2.7–5.5 kg category fruit than of the 5.5–8.2 kg fruit (Table 1). This indicates that the maturity separation was effective. Within a particular firmness category, the combination treatment and the SADH treatment were always significantly higher in a_L value (lower in discoloration) than the ethephon and control treatments. The USDA color scores of the combination and SADH treatments were also significantly higher (color enhanced) than the ethephon and control treatments, regardless of firmness category.

The most striking result of the experiment was the decrease in pit cavity discoloration noted when SADH, ethephon or both were applied (Table 1 and Fig. 1). Hunter L values for lightness were correlated with visual ratings of pit cavity discoloration, which whether measured objectively or subjectively, was always significantly less in the treated fruit.

The data clearly indicate that the yellow-orange color of the canned fruit was increased by SADH. This may have been due, at least in part, to the previously observed decrease in PPO activity and tannin content (5). The darker color of the control fruit was probably due, to some extent, to oxidative browning of the flesh; however, the lack of color of the ethephon-treated fruit was not a darkening of the flesh, but rather an absence of yellow pigment which resulted in a greyish appearance of the fruit. This response apparently was prevented by SADH in the combination treatment. The cheek color of ethephon and control fruit may have

Table 1. Cheek and pit cavity color of canned 'Redskin' peaches in response to preharvest sprays of SADH and ethephon.

Firmness range (kg)	Treatment	Cheek color: Hunter a_L	Cheek color: Visual score[x]	Pit cavity color: Hunter L	Pit cavity color: Visual score[y]
2.7–5.5	SADH/ethephon	5.55a[z]	17.3a	53.16a	4.7a
	SADH	5.42a	17.3a	50.79c	4.1bc
	Ethephon	3.24 c	15.8c	49.65e	3.3d
	Control	4.53b	15.9c	47.41f	1.8f
5.6–8.2	SADH/ethephon	2.91cd	16.4b	51.65b	4.9a
	SADH	2.65d	16.4b	49.99de	4.5ab
	Ethephon	1.26e	14.4d	50.41cd	4.0c
	Control	1.70e	14.1d	47.10f	2.4e

[x]USDA color score from 0 to 20, with 20 representing maximum color level.
[y]Rated from 0 to 5, with 5 representing no discoloration.
[z]Means separation, within columns, by Duncan's multiple range test, 5% level.

[3]Trade name and instrument model is included for the benefit of the reader and does not imply any endorsement or preference by Clemson University.

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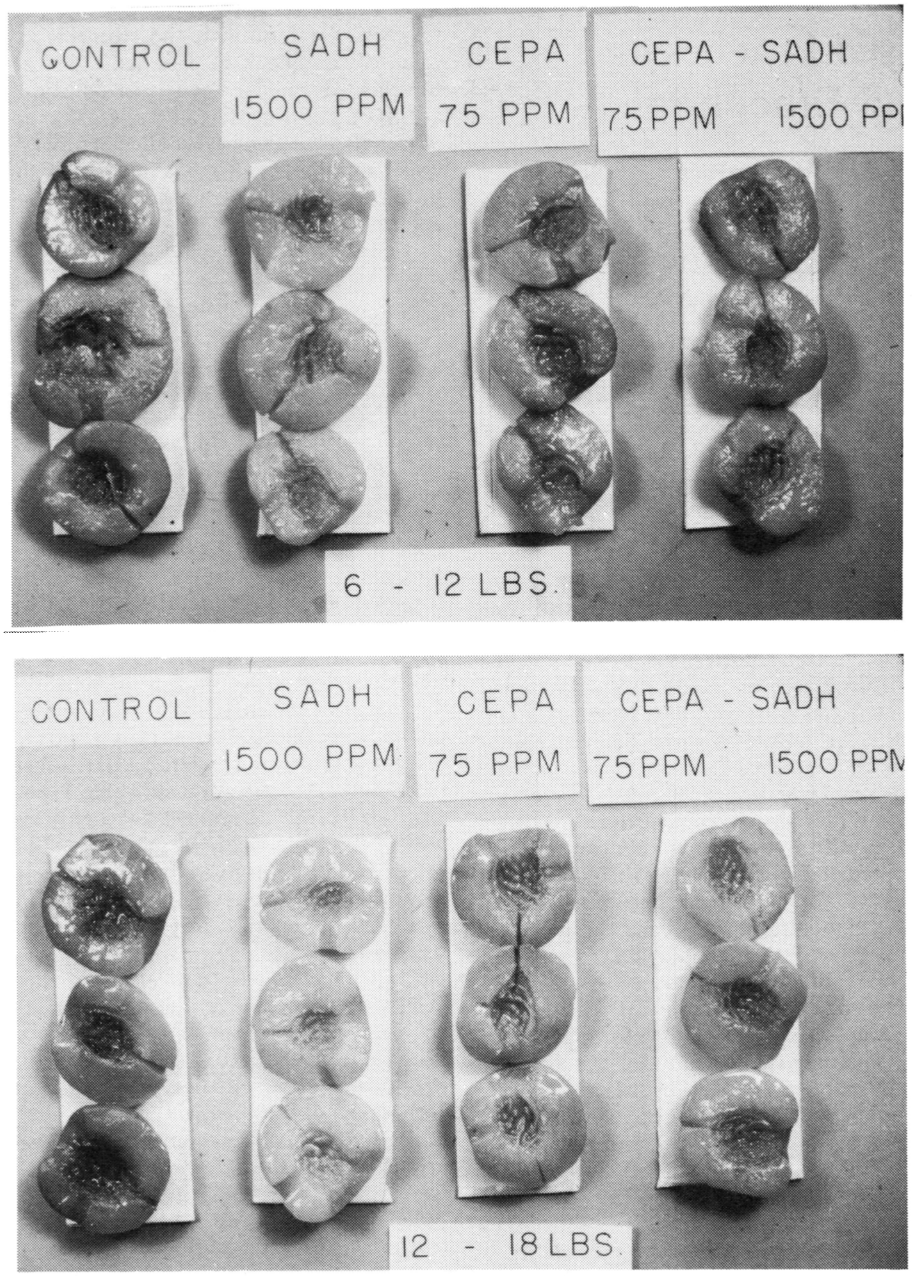

Fig. 1. Pit cavity discoloration of 2.7–5.5 kg fruit (top) and the 5.6–8.2 kg fruit (bottom). CEPA is ethephon.

differed because ethephon may have favored formation of a yellow pigment that is easily degraded during thermal processing. The brown control fruit and the greyish ethephon treated fruit were not significantly different in USDA color scores because the evaluator downgraded the control fruit for browning and dowgraded the ethephon treated fruit for lack of yellow color.

The discoloration that is quite common in the pit cavities of the late-ripening cultivar 'Redskin' was clearly affected by treatment with SADH and/or ethephon. In all cases, there was less darkening of the pit cavity when SADH and/or ethephon was used. We believe that this response was due at least in part to the decreased levels of PPO activity and tannin content. Low PPO activity would decrease the quantity of polyphenols (or tannins, also present in lesser amounts) converted to 4-methyl-o-quinones, which could be converted to brown polymers during or after processing.

Future studies should be directed toward establishing the effects of these and other growth regulators on other peach cultivars that are marginally or completely unsuitable for processing because of discoloration.

Literature Cited

1. Baumgardner, R. A., G. E. Stembridge, L. O. Van Blaricom, and C. E. Gambrell, Jr. 1972. Effects of succinic acid-2,2-dimethylhydrazide on the color, firmness, and uniformity of processing peaches. *J. Amer. Soc. Hort. Sci.* 97:485-488.
2. Hair, B. L. 1974. The effects of (2-chloroethyl) phosphonic acid, succinic acid-2,2-dimethylhydrazide and their combination on peach polyphenoloxidase activity and tannin content. MS thesis. Clemson University, Clemson, South Carolina.
3. Hunter, R. S. 1942. Photoelectric tristimulus colorimetry with three filters. Circular of the National Bureau of Standards C429. U.S. Government Printing Office, Washington, D.C.
4. Johnson, G., B. J. Donnelley, and D. K. Johnson. 1969. Proanthocyanins as related to apple juice processing and storage. *Food Technol.* 23:1312-1316.
5. Knapp, F. W., C. B. Hall, D. W. Buchanan, and R. H. Biggs. 1970. Reduction of polyphenoloxidase activity in peaches sprayed with alar, ethrel, or gibberellic acid. *Phytochemistry* 9:1453-1456.
6. Li, K. C., T. S. Bogess, Jr., and E. K. Heaton. 1972. Relationship of sensory ratings with tannin components of canned peaches. *J. Food Sci.* 37:177-178.
7. Luh, B. S., E. T. Hus, and K. Stachowicz. 1967. Polyphenolic compounds in canned cling peaches. *J. Food Sci.* 32:251-258.
8. ———— and B. Phithakpol. 1972. Characteristics of polyphenoloxidase related to browning in cling peaches. *J. Food Sci.* 37:264-268.
9. Ponting, J. D. 1960. The control of enzymatic browning of fruits. p. 105-124. *In* H. W. Schultz, (ed.) Food enzymes. The Avi Publishing Company, Westport, Conn.
10. Sansavini, S., J. M. Martin, and K. Ryugo. 1970. The effect of succinic acid-2,2-dimethylhydrazide on the uniform maturity of peaches and nectarines. *J. Amer. Soc. Hort. Sci.* 95:708-711.
11. Sims, E. T., Jr., J. T. McClary, Jr., C. E. Gambrell, Jr., and G. E. Stembridge. 1973. The quality of peaches as influenced by the plant growth regulators SADH, ethephon, 3-CPA and KGA. *S.C. Agr. Expt. Sta. Tech.* Bul. 1047.
12. Stembridge, G. E. and J. W. Raff. 1973. Ethephon and peach fruit development. HortScience 8:500-501.
13. U.S. Department of Agriculture, Agricultural Marketing Service, Fruit and Vegetable Division. Standards for grades of canned freestone peaches. 1973. Proc. Prod. Stand. and Insp. Branch.
14. Van Blaricom, L. O. and R. A. Baumgardner. 1973. Postharvest softening of peaches treated with succinic acid-2,2-dimethylhydrazide. *S.C. Agr. Expt. Sta. Tech. Bul.* 1048.