

LYE PEELING OF FLORIDA TOMATOES — EFFECTS OF TIME, TEMPERATURE AND CONCENTRATION

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ABSTRACT

Lye peeling studies on the tomato cultivar Homestead 24 and breeding line 2086 were conducted to determine the effects of time, temperature, and lye concentration on canned tomato yield and quality. Two periods of time (30 and 45 seconds), two temperatures (195 and 210 F), and two lye concentrations (17 and 21 percent) were evaluated for each variety. An additional time period (60 seconds) was evaluated with Homestead 24. Effects on product yield, total solids, pH, total acid and color were measured. With both varieties yield decreased with increasing time or with increasing temperature. The major portion of the peel was removed by all treatments. Time, temperature, or lye concentration had no effect on total solids, pH, total acidity or color.

INTRODUCTION

The peeling and coring of tomatoes for processing is a labor-intensive operation in the canning of Florida tomatoes. In some tomato processing areas of the country lye peeling has replaced steam peeling and considerable labor savings have been estimated (5).

Tomatoes have been lye peeled either before or after coring and the use of wetting agents has increased the peeling efficiency of lye solutions (7).

This study was undertaken to determine the effect of major peeling variables on canned tomato yield and quality and to determine the adaptability of some Florida tomato varieties to lye peeling. The Homestead variety was selected since it represents the main tomato variety now available to Florida canners. Breeding line 2086 was evaluated as it is one of the new lines for mechanical harvest.

EXPERIMENTAL METHODS

Tomatoes, cultivar Homestead 24, were obtained from the Gulf Coast Experiment Station, Bradenton and experimental line 2086-S1-D1-BGBK-CAVStw from the South Florida Field Laboratory, Immokalee. All tomatoes were mature-ripe, hand harvested and processed at Gainesville within 3 days of harvest.

A 3 x 2 x 2 factorial experiment with two replications was conducted with cultivar Homestead 24. Three lye immersion time periods (30, 45 and 60 seconds), two lye concentrations (17 and 21 percent), and two temperatures (195 and 210 F) were investigated. A 2 x 2 x 2 factorial experiment with two replications was conducted with breeding line 2086. Two time periods (30 and 45 seconds), two lye concentrations (17 and 21 percent), and two temperatures (195 and 210 F) were investigated.

The experiments were analyzed separately by analysis of variance. Varieties were compared for identical conditions by t-test procedure. Significance was determined at the 0.05 level.

The lye solution was maintained in an 80-gallon steam-jacketed kettle and a wetting agent (0.3 percent Faspell, Wyandotte Corp.) was used for all treatments. Tomatoes (7-lb. lots) were placed in a wire basket and immersed in the lye solution. Light agitation was maintained during the immersion period. The tomatoes were removed and allowed to drain for exactly 45 seconds, immersed in rinse water for 30 seconds, and then conveyed through water sprays (top and bottom) for 45 seconds.

The lye peeled tomatoes were cored, and the remaining peel and defects were removed. Percent yield was calculated on this material.

For comparison with lye peeled tomatoes, lots of tomatoes were steamed for 60 seconds in a steam-saturated conveyor tunnel and then sprayed with cold water for 30 seconds.

The tomatoes were hand packed into 303 cans (10.5-11.0 oz. per can), filled with juice prepared from tomatoes of the same treatment, and exhausted in a water bath to 100°F. They were then sealed and processed in a 212°F still cook for 30 minutes and water cooled immediately to approximately 100°F.

All evaluations, except for percent yield, were made on the canned products within 60 to 90 days after canning. Determinations were made by blending the entire contents of a can of tomatoes and examining aliquots of the blend for pH, total titratable acidity, total solids and color. Two cans from each replicate treatment were analyzed.

1. pH—measured on an aliquot of the undiluted blended tomato.
2. Titratable acidity—based on a weighed aliquot and expressed as percent (w/w) calculated as citric acid (4).
3. Total solids—based on a refractive index determination as outlined in Tomato Products section of reference 8.
4. Color—Determined by Hunter Color and Color Difference Meter on blended tomato sample which had been deaerated under vacuum. Standard values were Rd=7.0, a=33.9 and b=16.2. Color was reported as the ratio of a/b values, and the higher the ratio the redder the tomato.
5. Percent yield—weight of peeled and cored tomatoes divided by the weight of original tomato sample.

RESULTS

Peel Removal—All lye treatments resulted in removal of the major portion of the peel. The peel had a tendency to stick around the stem end and, to a much lesser degree, at the blossom end. This was more pronounced with yellow shoulder tomatoes. The treatments of 60 seconds and 210 degrees with Homestead 24 were much too harsh and in some instances penetrated the locular cavity. The mildest treatment (30 seconds, 195 F, 17 percent lye) satisfactorily re-

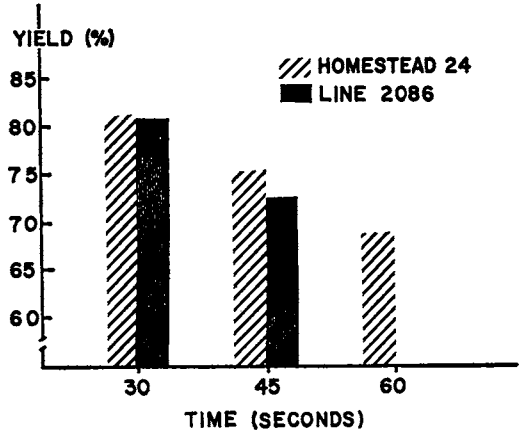


Fig. 1.—The effect of lye immersion peeling time on the yield of tomatoes for canning.

moved the peel from the main body of the tomato.

Yield—The effect of time on yield (Table 1) was significant for both Homestead 24 and line 2086. Yield decreased as the period of time increased (Figure 1) and the decrease was linear for Homestead 24. Highest average yield for both varieties was at 30 seconds (81.0—Homestead 24 and 80.6—2086).

Temperature effect was significant for both varieties, with a decrease in yield with increased temperature. Yields at the two lye concentrations were not different. Variety response for yield was compared at the 30 and 45 second time levels and was not different. Yield of steam peeled tomatoes (83.9 percent—Homestead and 84.6—2086) was higher than the yield for lye peeled tomatoes.

Percent Titratable Acidity—The average percent acid was 0.31 for both Homestead 24 and

Table 1. Percent yield of lye peeled and steam peeled tomatoes.¹

Variety	Lye peeled						Steam Peeled	
	Time (seconds)			Lye percent		Temperature (°F)		
	30	45	60	17	21	195		210
Homestead 24	81.0a	75.1b	68.6c	74.8a	75.1a	77.0a	72.8b	83.9
2086	80.6a	72.5b		76.5a	76.6a	78.8a	74.4b	84.6

¹ Means, within horizontal groups, followed by the same letter are not different at the 0.05 level of significance.

Table 2. Percent titratable acidity of lye peeled and steam peeled tomatoes.¹

Variety	Lye peeled						Steam Peeled	
	Time (seconds)			Lye percent		Temperature (°F)		
	30	45	60	17	21	195		210
Homestead 24	.31a	.31a	.32a	.31a	.32a	.31a	.32a	.33
2086	.32a	.31a		.32a	.31a	.31a	.32a	.34

¹ Means, within horizontal groups, followed by the same letter are not different at the 0.05 level of significance.

line 2086 (Table 2). There was no significant main effect or interaction for time, temperature, or lye concentration for Homestead 24 or 2086. The average percent acid for steam peeled Homestead tomatoes was 0.33 and for 2086 was 0.34; these values were not different from the lye peeled tomatoes.

pH—Mean treatment values for pH ranged from 4.52 to 4.59 (Table 3). There was no main effect on pH with either Homestead 24 or line 2086. The average pH values of steam peeled (4.52) and lye peeled (4.58) Homestead tomatoes were not different. However, there was a difference (10 percent level) between the average pH value of steam peeled (4.44) and lye peeled (4.55) line 2086 tomatoes.

There was a Time x Temperature interaction for pH with Homestead tomatoes.

At the low (195°) temperature, the average pH increased as the period of time increased. At the high (210°) temperature, the average pH decreased as the time increased.

Color—The range of means for color ratio was 1.64 to 1.81 (Table 4). There were no main

effects on color for either Homestead or variety 2086, nor was there any difference between the average color of steam peeled tomatoes (1.73 for Homestead, 1.73 for 2086) and lye peeled tomatoes (1.74 for Homestead, 1.68 for 2086).

There was a Time x Lye interaction for color in variety 2086. At the low (17 percent) lye concentration, the average color increased as the period of time increased. At the high (21 percent) lye concentration, the average color decreased as the period time increased.

Total Solids—Mean total solids for the variety Homestead 24 was 5.72 percent and for line 2086 was 5.62 percent (Table 5). There were no main effects of time, temperature, or lye concentration on total solids, nor was there any difference between the average total solids of steam peeled tomatoes (5.7) and total solids of lye peeled tomatoes.

There was a Time x Lye interaction for total solids with variety 2086. At the low (17 percent) lye concentration, the average solids increased as the period of time increased. At the high (21

Table 3. pH of lye peeled and steam peeled tomatoes.¹

Variety	Lye peeled						Steam Peeled	
	Time (seconds)			Lye percent		Temperature (°F)		
	30	45	60	17	21	195		210
Homestead 24	4.58a	4.58a	4.57a	4.58a	4.58a	4.59a	4.56a	4.52
2086	4.52a	4.59a		4.54a	4.56a	4.54a	4.57a	4.44

¹ Means, within horizontal groups, followed by the same letter are not different at the 0.05 level of significance.

Table 4. Color (a/b ratio) of lye peeled and steam peeled tomatoes.¹

Variety	Lye peeled						Steam Peeled	
	Time (seconds)			Lye percent		Temperature (°F)		
	30	45	60	17	21	195		210
Homestead 24	1.72a	1.81a	1.67a	1.80a	1.68a	1.69a	1.78a	1.73
2086	1.69a	1.66a		1.68a	1.67a	1.71a	1.64a	1.73

¹ Means, within horizontal groups, followed by the same letter are not different at the 0.05 level of significance.

percent) lye concentration the solids decreased as time increased.

DISCUSSION

The large effects of lye immersion time and temperature on yield, point out areas requiring close processing control. Since the major portion of peel was removed by all treatments, it is probable that treatment times shorter than 30 seconds would give satisfactory peeling and increased yields. Highest yields were obtained at 30 second immersion times and 195 F.

With the precautions that were taken to wash the lye solution from the peeled tomatoes there was no difference in pH or total acidity between steam peeled and lye peeled tomatoes. However, since the pH of the canned product (mean value 4.58) was so high acidification of lye peeled tomatoes should be evaluated.

Product quality of lye peeled tomatoes as measured by pH, total acidity, solids and color did not differ from the steam peeled tomatoes.

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Table 5. Percent total solids of lye peeled and steam peeled tomatoes.¹

Variety	Lye peeled						Steam Peeled	
	Time (seconds)			Lye percent		Temperature (°F)		
	30	45	60	17	21	195		210
Homestead 24	5.71a	5.69a	5.77a	5.72a	5.72a	5.73a	5.71a	5.65
2086	5.65a	5.59a		5.65a	5.59a	5.59a	5.65a	5.70

¹ Means, within horizontal groups, followed by the same letter are not different at the 0.05 level of significance.