KOREAN J. FOOD SCI. TECHNOL.
Vol. 4, *No.* 1 (1972)

Effect of Ripening and Peeling Methods on Composition and Quality of Canned Freestone Peaches

by

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(Received November 23, 1971)

Abstract

Fay Elberta freestone peaches were harvested at four maturity levels as judged by skin color and firmness. They were ripened at 68°F under 80 percent relative humidity for 4, 6, 8 and 10 days respectively prior to canning. Results indicate that both harvest maturity and ripening conditions are important factors influencing quality, flavor and composition of canned freestone peaches.

Peaches harvested at 18~24 pounds on a Magness-Taylor pressure tester with a 7/16″ plunger(M1) failed to ripen satisfactorily. Fruits harvested at 13~17 pounds (M2) pressure test ripened successfully at 68°F within 6 to 8 days; and those harvested at 6 to 12 pounds (M3) needed 4 days for ripening at 68°F. Tree-ripened fruits (M4) were undesirable for canning because of the high percentage of bruised fruits. The optimum firmness for canning appears to be in the range of 1.5 to 3.0 pounds.

The titratable acidity of peaches decreased during maturation and ripening. The tannin content of peaches at M1 maturity decreased with ripening at 68°F. But no appreciable change was observed in the M2 and M3 series which were ripened at 68°F for 4 to 10 days. The volatile reducing substances (V.R.S.) increased as the peaches developed on the tree and also during post-harvest ripening. The effect of harvest maturity and post-harvest ripening on color grade of the canned peaches is presented.

Little difference was found in the flavor and composition of peaches peeled by the cup-down lye peeling and the steam-peeling methods. The cup-down lye-peeling method might be most advantageous because of its higher peeling efficiency.

Introduction

Peach is one of the important fruits canned in California. Fay Elberta and Elberta are the two major freestone peaches used for canning. Bedford and Roberstone(1955) studied harvest maturity and ripening of peaches in relation to the quality of canned and frozen products. Van Blaricom and Musser (1950) reported that peaches ripened off the tree were better in color and texture than tree-ripened fruits. Neubert *et al.* (1944) stated that fruits picked 6 days before reaching the tree-ripened stage gave a better canned product than those picked 3 days later. Rood (1957) used pressure test, skin color, flesh color and titratable acidity to evaluate maturity of California grown freestone peaches.

Neubert *et al.* (1948) found no appreciable change in soluble solids during maturation. The effect of maturity and storage on firmness and chemical composition of apricots and peaches was studied by Deshpande and Salunkee (1964). Softening was mainly due to enzymatic degradation of protopectin to soluble pectin, and also by solubilization of cell wall content and cells. Shewfelt (1965) examined several freestone peach varieties at four post-harvest stages for firmness and pectinesterase activity. He concluded that firmness of

fresh and canned products was related to the pectin content.

Wankier *et al.* (1970) studied effect of control atmosphere storage on biochemical changes in apricots and peaches. Ben-Arie *et al.* (1970) demonstrated the control of woolly breakdown of Elberta peaches by removing the fruit to ambient room temperature (23~25°C) for 48 hours after 2 and 4 weeks storage at 0°C. Luh *et al.* (1962) reported on brown discoloration in canned freestone peaches. Leucoanthocyanins in fresh and canned freestone peaches have been reported by Luh and Villarreal (1964).

Freestone peaches may be peeled either by steam or lye. If the peaches are not fully ripe, they cannot be peeled successfully by steam. Lye-spray peeling can overcome such difficulty. Lankler and Morgan(1944) reported the use of wetting agent to improve the chemical peeling process.

In this investigation, the effects of harvest maturity, post-harvest ripening and peeling methods on composition and quality of canned freestone peaches were determined.

Materials and Methods

A. Peaches

Four hundred pound lots of Fay Elberta peaches were picked from a commercial peach orchard on different days at four stages of maturity. A Magness-Taylor pressure tester with a 7/16″ plunger was used to determine firmness. The average pressure tests and color at harvest time are as follows: (a) M1 maturity, 10 to 12 days before tree ripeness, green skin color, and pressure tests at 18~24 lbs; (b) M2 maturity, 7 to 9 days before tree ripeness, green-straw skin color, and pressure tests at 13~17 lbs; (c) M3 maturity, 4 to 6 days before tree ripeness, straw yellow skin color, pressure tests at 6~12 lbs; and (d) M4 maturity, ready to eat, yellow skin color, and pressure tests at 2~5 lbs.

The peaches were ripened at 68°F under 80 percent relative humidity for 4, 6, 8 and 10 days respectively. The M4 maturity peaches were kept at 68°F for three days prior to canning.

B. Canning

The peaches were halved, hand pitted, peeled in a cup-down peeler with a 2% sodium hydroxide spray at 212°F for 38 seconds, and then washed with a cold water spray. Exactly 19± 0.1 oz of peeled peach halves and 11 oz of 46° Brix sucrose solution were packed into each No. 2 1/2 (401×411) plain tin can. The cans were sealed in a double seamer under a vacuum of 15 inches Hg. The sealed cans were heat processed in a rotary cooker at 212°F for 23 minutes, cooled in a rotary water cooler for 7 minutes, and stored at 32°F for 3 months before physical and chemical evaluations were made.

C. Peeling methods

Fay Elberta peaches were harvested at M3 maturity, ripened at 68°F under 80 percent relative humidity for 4 days, and then peeled with: (a) 2% sodium hydroxide lye spray on the cup-down peach halves at 212°F for 38 sec; (b) steam peeling at 208°F for 70 sec; and (c) 2% sodium hydroxide lye-spray at 212°F for 105 sec. The canning procedure was the same as that described earlier.

D. Analytical methods

1. Soluble solids. The soluble solids were determined with a Zeiss-Optom refractometer at 20°C.

2. Total titratable acidity. Ten grams of the macerated sample (peach and syrup) was weighed into 250 ml beakers in duplicate. Then 200 ml of distilled water was added. The mixture was titrated with 0.1 N NaOH to pH 8.0, using a Beckman model K titrator. Total acidity was expressed as percent anhydrous citric acid (Leonard *et al.*, 1953). The pH of the macerated fruit was determined with a Beckman Zeromatic glass electrode pH meter.

3. Pressure test. A Magness-Taylor tester with a pressure range of 3~30 pounds (7/16″ plunger) was used for testing firm fruits. For soft fruits, a 0~10 lb pressure tester was used. The cheek side of each peach was peeled before testing. The average value of twenty readings represented the firmness of the fruit.

4. Tannins. The Folin-Denis method described by Guadagni (1949) was used. The results are reported as mg tannic acid per 100 g sample (Leonard *et al.*, 1953).

5. Ascorbic acid. The 2,6-dichlorophenolindophenol titration method described by the Association of Vitamin Chemists and Leonard *et al.* (1953) was used.

6. Volatile reducing substances. Volatile reducing substances in the canned peaches were determined by the alkaline permanganate titration of the steam

distillate as described by Leonard *et al.* (1953).

7. Flavor and color. A panel of 14 persons scored and ranked the color of the canned peaches. The 13 samples were randomized and graded for color with five replications under a standard light source. Flavor evaluation was done by an incomplete block design method, using 4 samples at a time (Cochran and Cox, 1950). The color and flavor were scored on a ten point scale: excellent, 9~10; good, 7~8; fair, 5~6; poor, 3~4; and very poor, 1~2. In the ranking system, a smaller number represents a better product. The results of organoleptic evaluation were analyzed statistically.

8. Total carotenoids and beta-carotene. The method described by McCollum (1953) was used.

9. Trichromatic coefficients. The peach samples were blended for 30 seconds in a Waring blendor and deaerated under vacuum to remove air bubbles. The reflectance readings were taken with a three-filter Differential Colorimeter (Color Master Engineering and Equipment Corp., Hatboro, Pa.). The readings were converted to the trichromatic coefficients in the C.I.E. (International Commission on Illumination) system. The colorimeter was standardized against a yellow plate. Six readings were made on each sample and the average values used for calculation.

$$X=0.784+0.196\ B$$
$$Y=G$$
$$Z=1.18\ B$$

In the equation, R, B, and G represent percent reflectance of light when red, blue, and green filters were used. With the following equation, the trichromatic coefficients in the C.I.E. system were calculated from the tristimulus values.

$$x=\frac{X}{X+Y+Z}$$
$$y=\frac{Y}{X+Y+Z}$$

The handbook of colorimetry (Hardy, 1936) was used to calculate dominant wave length, purity, and brightness.

Results and Discussion

A. Post-harvest ripening study

The effect of harvest maturity and post-harvest ripening on quality and chemical composition of canned freestone peaches was investigated. Fay Elberta peaches were harvested at four maturities as described in the

Table 1. Effect of harvest maturity and ripening on chemical composition of canned Fay Elberta peaches

Sample	Harvest[a] Maturity	Ripening at 68°F, 80%R.H days	Ave. Pressure Test at Canning, lbs. (7/16" Plunger)	pH	Brix at 20°C	Titratable acidity as citric acid %	Brix to Acid ratio	Tannins, mg/100g	Ascorbic acid, mg/100g	V.R.S. as micro eq. $KMnO_4$ per 100g	Average flavor rank[b]
1	M1	4	6.1±2.2	3.63	24.98	0.453	55.1	100.2	1.65	177.0	13.5
2	M1	6	3.5±0.8	3.70	23.98	0.428	55.8	109.6	1.45	221.3	11.2
3	M1	8	2.7±0.6	3.70	24.08	0.420	57.3	111.7	1.77	274.5	10.3
4	M1	10	1.9±0.6	3.75	23.68	0.430	55.1	92.5	1.80	345.3	10.5
5	M2	4	4.1±1.4	3.65	23.88	0.386	61.9	76.9	1.84	178.5	10.1
6	M2	6	2.0±0.7	3.70	24.44	0.403	60.6	86.9	1.84	247.9	9.0
7	M2	8	3.7±0.7	3.71	23.98	0.390	61.5	84.2	2.04	324.0	8.8
8	M2	10	1.8±0.3	3.75	24.19	0.375	64.5	86.2	2.04	317.0	8.9
9	M3	4	1.8±1.3	3.80	24.14	0.349	69.2	75.4	1.89	232.0	8.6
10	M3	6	2.2±0.6	3.85	24.28	0.369	65.8	82.6	1.94	271.8	9.2
11	M3	8	1.9±0.3	3.86	23.85	0.334	71.4	80.3	1.99	347.1	9.4
12	M3	10	2.1±0.7	3.90	23.68	0.300	82.3	83.7	1.75	440.9	10.2
13	M4	3	2.1±0.7	3.90	24.78	0.301	82.3	76.7	2.04	261.6	10.3

a. Pressure test of the peaches at harvest maturity (7/16", plunger) : M1, 18-24; M2, 13-17; M3, 7-12 and M4, 2-6 lbs.

b. The smaller numbers represent better peach flavor. Incomplete balance block (Cochran and Cox: pg. 333, plan 11.22). Four samples/day for 13 days. Blocks and serving order randomized.

Materials and Methods section, ripened at 68°F under 80% relative humidity, and then canned in No. 2 1/2 cans.

1. pH and titratable acidity

The pH value increased and titratable acidity decreased during maturation and post-harvest ripening(Table 1). Peaches picked at Ml maturity followed by ripening at 68°F for 10 days had a higher titratable acidity and lower pH than those harvested at M2 maturity and ripened for 4 days.

2. Brix to acid ratio

The Brix readings of the peaches canned at different ripeness levels are shown in Table 1. The Brix/acid ratio gradually increased as the fruits ripened. Proper control of the Brix/acid ratio appears to be important to flavor acceptance of the canned products. The optimum ratio for better flavor (Table 1) was in the range of 60 to 70.

3. Tannin-like substances

Tannin-like substances are related to bitterness and astringency of peaches. The tannin content decreased with maturation on the tree (Table 1). Samples harvested at Ml maturity were higher in tannin content than those harvested at M2, M3, and M4 maturity. This is an important obserovatin since tannins are related to the flavor acceptance of canned peaches. The tannin contents showed no distinct trends during post-harvest ripening at 68°F. Neubert *et al.* (1948) reported that tannins in peaches decreased rapidly until 7 days before the canning-ripe stage, and remained fairely constant from then on.

4. Ascorbic acid

The ascorbic acid content of peaches increased slightly with maturation (Table 1). No definite trend was observed during ripening.

5. Volatile reducing substances (V.R.S.)

The volatile reducing substance content of peaches increases as the fruits mature on the tree and also during the post-harvest ripening period (Table 1). More V.R.S. were formed during ripening than during maturation on the tree. The V.R.S. content appeared to be related to the flavor acceptance of the canned product. These substances include alcohols, carbonyl compounds, esters, and other components which are associated with flavor and aroma of peach (Luh, 1971). When the V.R.S. contents were exceedingly high, an off-flavor developed.

6. Flavor

The effects of harvest maturity on the flavor of canned freestone peaches are presented in Table 1. Those harvested at Ml maturity improved gradually in flavor during ripening at 68°F. Fruits harvested at M2 or M3 maturity and canned after 6 to 8 days' ripening, were ranked better in flavor than others. Peaches picked at M4 maturity and canned after ripening for 3 days were less attractive in flavor as compared with those of the M2 and M3 series.

Achieving the best quality in canned peaches is not a simple task. Formation of aromatic compounds, decrease of astringent material, softening of texture, and other biological changes during ripening all contribute to quality changes. In addition to these, proper Brix/acid ratio in the canned product is also an important factor to be considered. The ripeness level of the fresh peaches at canning is an important factor influencing the flavor of the canned products. It is important to control the harvest maturity and post-harvest ripening procedure to obtain excellent quality in the canned product.

7. Carotenoids

An increase of both total carotenoids and beta-carotene accompanied maturation and ripening (Table

Table 2. Effect of harvest maturity and ripening on carote noid content and color of canned Fay Elberta peaches

Sample	Harvest maturity	Ripening time at 68°F, 80%R.H days	Beta carotene, mg/100g	Total carotenoids mg/100g	Beta carotene in total pigments %	Visual color		Dominant wave length, mu	Purity %	Brightness %	Trichromatic coefficients	
						Ave. rank[a]	Ave. score[b]				*x*	*y*
1	M1	4	0.370	0.408	90.6	12.00	3.28	576.6	65.7	29.86	0.4281	0.4435
2	M1	6	0.540	0.600	90.0	10.22	4.60	578.0	72.1	28.83	0.4465	0.4492
3	M1	8	0.590	0.678	87.0	8.64	5.82	578.5	71.2	29.86	0.4476	0.4452

4	M1	10	0.620	0.708	87.5	5.58	7.16	578.6	73.5	29.98	0.4521	0.4490
5	M2	4	0.470	0.600	73.3	10.16	4.56	577.8	69.9	29.56	0.4408	0.4452
6	M2	6	0.640	0.674	94.9	6.74	6.88	578.6	73.4	28.58	0.4521	0.4488
7	M2	8	0.520	0.702	74.1	4.10	8.28	578.9	72.6	30.53	0.4520	0.4455
8	M2	10	0.590	0.772	77.2	2.42	8.78	578.5	74.0	30.28	0.4524	0.4501
9	M3	4	0.730	0.736	96.5	6.80	7.04	578.8	71.4	29.13	0.4492	0.4438
10	M3	6	0.740	0.760	97.4	4.28	8.08	579.2	73.7	29.37	0.4556	0.4460
11	M3	8	0.755	0.764	98.2	3.04	8.74	579.2	74.7	29.37	0.4570	0.4480
12	M3	10	0.820	0.824	99.5	4.02	7.90	579.3	73.8	29.43	0.4554	0.4458
13	M4	3	0.860	0.870			98.9	579.4	74.0	27.98	0.4570	0.4452

a. Least significant difference: 1.96 at 1%, 1.47 at 5% probability levels. Smaller number indicates better color.
b. Ave. color score was graded five times by twelve judges who scored an excellent sample, 9~10; good, 7~8; fair, 5~6; poor, 3~4; and very poor, 1~2.

2). The increase in carotenoid content was greatest in green fruits requiring the longest time to ripen.

8. Color

The visual color score and rank of the canned peaches are presented in Table 2. In general, ripening improves the visual color. The best color was obtained when peaches were picked at M2 or M3 maturity and then ripened for 8 days. Color data of the canned freestone peaches as measured by the Colormaster Differential Colorimeter are presented in Table 2. The U.S.D.A. color grades of canned peaches of different harvest maturities are shown in Table 3. Most of the samples were of fancy or choice color grades.

Peaches harvested at M2 or M3 maturity followed by ripening at 68°F for 6 to 8 days were superior in color, flavor, and general acceptability to those harvested at other maturities. This procedure decreased bruising and increased case yield per ton of fresh fruit. When peaches were harvested at M1 maturity, the color and flavor of peaches never developed fully. They had an undesirable, astringent flavor, and a rubbery texture. In addition to this, since fruit is not fully developed in size at this state, the yield per acre would be lowered. Therefore, it is undesirable to harvest freestone peaches at the M1 stage. On the other hand, when peaches harvested at the M4 maturity (tree-ripe) were used, a larger portion of the fruits were bruised and the loss of fresh peaches would be more. The optimum pressure for canning ranged from 1.5 to 3.0 pounds on a Magness-Taylor pressure tester with a 7/16" plunger.

Table 3. Effect of harvest maturity on U.S.D.A. color grades of canned Fay Elberta peaches

Sample	Harvest maturity	Ripening time at 68°F, 80% R.H., days	Ave. pressure test at canning, lbs. (7/16" plunger)	Ave. U.S.D.A. color score	U.S.D.A. color grade[a]
1	M1	8	2.7±0.6	15.3	Choice
2	M2	8	3.7±0.7	18.1	Fancy
3	M3	8	1.9±0.3	18.8	Fancy
4	M4	3	2.1±0.7	16.0	Choice

a. Fourteen persons graded the color according to U.S.D.A. standards. Results are the average of 5 replicates. Fancy colored peaches were scored 18~20 points; choice, 15~17; standard, 12~14; and substandard less than 11 points.

B. Lye-spray vs steam peeling

An experiment was carried out to study the effect of peeling methods on quality of canned Fay Elberta peaches. The results are presented in Table 4.

Sample C which was peeled cup-down with 2% sodium hydroxide spray at 212°F for 105 sec was slightly higher in pH and lower in titratable acidity than the steam peeled sample B. As the flavor of the canned product is closely related to its acidity, it is

important to control the lye concentration and the duration of exposure to the lye. Information gathered here indicates that spraying with 2 per cent sodium hydroxide solution at 212°F for 38 second was sufficient to peel the product properly.

Residual lye has to be washed away in order to maintain the natural pH of the fruit. Culpepper *et al.* (1955) showed that the pH value of the outer surface of peeled peaches ranged from 4.3, to 6.2, depending on the type of washer and also whether the fruit was blanched after lye peeling. Thus the lye peeling must be carefully controlled. Volatile reducing substances are known to be related to the flavor acceptance of the canned product. The quantity of V.R.S. decreased when the peeling time was lengthened.

Sample A (peeled with 2.0% lye-spray at 212°F for 38 seconds) was ranked better in appearance and flavor than sample B (steam peeled at 208°F for 70 seconds) and sample C (lye-peeled at 212°F for 105 seconds).

The appearance of the lye-peeled peach halves might become poor if the lye concentration, temperature and time of peeling are not adequate. In severe cases the peeled surface may become uneven and ragged. The

Table 4. Effect of peeling method on chemical composition and quality of canned Fay Elberta peaches

Sample	Peeling	pH	Brix at 20°C	Acidity as citric acid,%	Ascorbic acid mg/100g	Tannins mg/100g	Ave appearance rank	V.R.S. as micro eq of $KMnO_4$ per 100 g	Ave. flavor rank[a]
A	2% lye peeling at 212°F for 38 sec.	3.70	24.13	0.433	2.14	88.21	1.25	398.5	1.84 — N.S.
B	Steam peeling at 208°F for 70 sec.	3.74	24.48	0.429	2.38	89.02	2.01	368.2	2.02 — N.S.
C	2% lye peeling at 212°F for 105 sec.	3.81	23.71	0.401	1.80	88.07	2.74	303.2	2.14 — N.S.

a. N.S. means not significant at the 95% probability level.

pressure of the water-spray emerging from the spray nozzle should be kept below 5 psi, so that the impact of the washing water on the peeled area will be gentle.

Culpepper *et al.* (1955) studied the effect of harvest maturity and ripening on steam peeling. They reported that "ease of peeling" was influenced both by harvest maturity and ripening temperature. Peaches picked in a very early or immature stage of maturity did not peel readily after ripening at any of the temperatures used and those ripened at 95°F did not peel well even when they were harvested in a later stage of maturity. Those harvested at a maturity stage requiring 6 days to ripen at 75°F were easiest to peel. This indicated the importance of the ripeness level to the steam peeling process.

Recently, a new method known as the USDA-Magnuson infrared anti-pollution peeling process (Willard, 1971) uses infrared energy to condition the surfaces of potatoes treated with strong sodium hydroxide solutions. The peel can be removed mechanically by soft rubber scrubbing rolls rather than by water as is done in conventional caustic peeling. A final spray rinse using low volumes of water removes residual peel fragments and excess hydroxide. The effluent from the peeled potato rinsing may be combined with the solid material generated to produce a thick, yet pumpable product. Direct comparison of the new process with conventional peeling has demonstrated that the strength of the waste discharge has been reduced by 40 per cent (Graham *et al.*, 1971).

The dry caustic peeling method has been studied for peeling of clingstone peaches and pears but not on freestone peaches. Because of the soft texture of freestone peaches, the dry caustic peeling method may

not be suitable. The steam peeling or lye-spray peeling methods will be continued for some time in commercial canning of freestone peaches. The results of this study indicate no significant difference in flavor of peaches peeled by the cup-down lye or steam peeling methods. However, the lye-spray peeling method is more efficient and economical for large scale operations.

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