

Gray and Congo watermelons of the same estimated maturity (Table 3). These 384 melons were classified as ripe or overripe after they were cut. The average soluble solids for overripe melons in any lot were higher than the solids for the ripe melons. However, the average weights and correlation coefficients were quite variable.

SUMMARY

The relationships of specific gravity, melon weight, and total soluble solids were studied for 1037 individual watermelons. Specific gravity tended to decrease, and soluble solids and melon weight increase with advancing maturity. Correlations between melon size on a weight basis and total soluble solids were positive and significant among melons of varying maturities. However, among melons of approximately the same maturity, neither the large nor small melons had higher soluble solids.

Correlation coefficients between specific gravity and soluble solids varied from -0.015 to $+0.596$ among 15 lots of watermelons of three varieties. Although 10 of the 15 coefficients

were statistically significant, the use of specific gravity for determining maturity of watermelons has little value because of wide variations among individual melons.

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SOME OBSERVATIONS ON HOLDING 6-OZ. CANS OF FROZEN CONCENTRATED ORANGE JUICE AT ROOM TEMPERATURE AND 40°F. — A PRELIMINARY REPORT

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The production of approximately 78,000,000 gallons of 42° Brix frozen concentrated orange juice in Florida during the 1959-60 season is a far cry from the 226,000 gallons processed in 1945-46. This tremendous increase in volume has also resulted in a continual improvement in sanitary practices, establishment of superior sanitary standards, and the use of most modern processing equipment. For example, juice after leaving the extractors is handled entirely in stainless steel equipment and not touched by human hands. Equipment is designed for easy cleaning and is readily accessible. In-plant chlorination of water is normal practice as is use of highly chlorinated water for sanitizing after cleaning. These improvements have resulted in a minimum of microbial problems

during processing operations and the ability to maintain finished product plate counts of canned, frozen concentrated orange juice at levels well below 25,000 microorganisms per ml. (Table 1).

It is a known fact that microorganisms die rather than grow when citrus concentrate is stored at 0 to -10°F . (1, 2, 6). However, it is also known that these temperatures are not always maintained in delivering product from public warehouses to retail outlets and between the time it is purchased and consumed. Not much is known as to how the consumer handles the product, but it is felt that a certain percentage of concentrate is not kept frozen once it is brought home from the market. It may be placed in the refrigerator (40°F .) and we know of instances when product has been stored unrefrigerated on kitchen shelf or pantry. Lorant (3) in his study on distribution and handling of frozen fruits, vegetables and juices states the major sources of adverse exposure

TABLE I

FINISHED PRODUCT COUNTS FOR FROZEN CONCENTRATED ORANGE JUICE (42° Brix)1960-61 SeasonMonthly Averages

<u>Month of Operation</u>	<u>Plant No. 1</u>		<u>Plant No. 2</u>		<u>Plant No. 3</u>	
	<u>No. Samples Examined</u>	<u>Avg. Org. per ml.</u>	<u>No. Samples Examined</u>	<u>Avg. Org. per ml.</u>	<u>No. Samples Examined</u>	<u>Avg. Org. per ml.</u>
Jan.	94	2,417	242	4,514	111	2,143
Feb.	88	3,085	146	3,350	126	4,544
Mar.	<u>Midseason Break</u>					
Apr.	52	5,533	137	3,223	61	3,302
May	104	10,376	221	8,952	50	4,412
June	40	19,455	83	11,039	Not Operating	

NOTE: All counts are recorded on a reconstituted juice basis.

for frozen concentrated orange juice are (1) transportation, (2) break-up operation, (3) retail store, and (4) home storage. Of the four categories mentioned, the greatest abuse occurred during home storage.

Frozen concentrated citrus juices contain viable microorganisms, even though the product may have a relatively low microbial population. Therefore, any time concentrate is held in a thawed condition at temperatures favorable for microbial growth (usually 40°F. or higher) spoilage will eventually develop. When this occurs the ends of the container no longer remain flat but become distended. If growth continues the can will explode due to excessive internal pressure (Figure 1).

It is entirely possible along the distribution route between processor and consuming public that an occasional can of frozen concentrated citrus juice may be exposed to conditions favorable for spoilage to develop. The consumer, unknowingly, may open a swelled can or have one explode while in his or her possession. When this occurs the customer's reaction

is usually to contact the manufacturer seeking restitution for damage done to personal effects and household items. Fortunately, these types of complaints are few. For example, our experience in Florida between 1957 and 1960 showed that consumer complaints on can swells and/or explosions for 6 and 12-oz. cans of frozen concentrated orange juice ranged, on the basis of each 10,000,000 units sold, from 0.77 to 1.55 (5). Despite this extremely low incidence, chronic complaints of this type are of concern to the frozen concentrated citrus industry because it is their desire that the customer be completely satisfied with product purchased.

In view of these facts, the effect of exposing frozen concentrated orange juice to adverse storage temperatures was investigated. This paper covers product collected during the mid-season portion of the 1960-61 pack. It concerns (1) the length of time required for 6-oz. cans of frozen concentrated orange juice to swell and explode at room temperature (68 to 74°F.), and for swells to develop at 40°F., and (2) the growth of microorganisms in the product

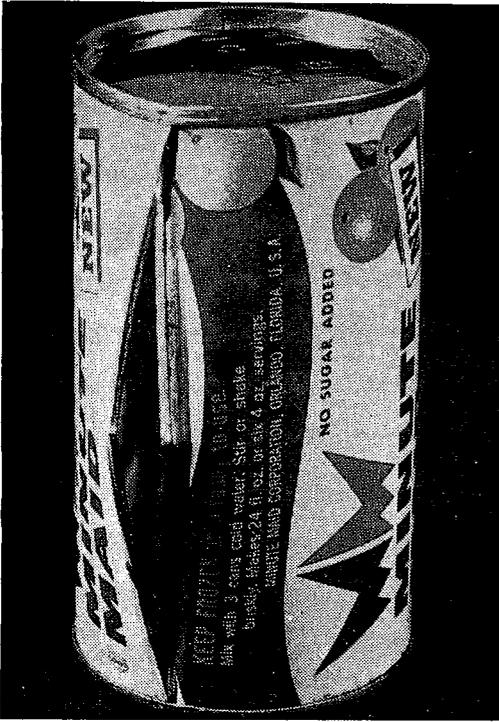


Figure 1. Six-ounce can which contained frozen concentrated orange juice. Container burst at side seam after 3 days' storage at room temperature (68 to 74°F.).

at these temperatures. Data covering the Valencia season will be presented at a later date.

PROCEDURE

Twelve 6-oz. cans of frozen concentrated orange juice were collected from the freeze tunnel at the end of each evaporator run, which during the midseason portion of the 1960-61 pack ranged from 60 to 72 hours. The cans were coded and placed immediately at 0 to -10°F. Four to 8 hours after the plant was again in operation following a clean-up a similar set of samples was obtained. This sampling procedure was adhered to at plant No. 1 where a conventional process was being used, and plant No. 2 which was using a new process for production of concentrate. Collection of concentrate before and after clean-up was selected because it was felt this would give maximum and minimum contamination in the product. Samples were collected from January 12 through March 9, held from 2 weeks to 3 months in cold storage and then all removed together.

A total of 150 cans (100 from plant No. 1, and 50 from plant No. 2) were selected so as to contain product before and after clean-up. These were placed at room temperature (68 to 74°F.) to be examined visually for swells

Figure 2. Spoilage developing at room temperature in 6 oz. cans of orange concentrate

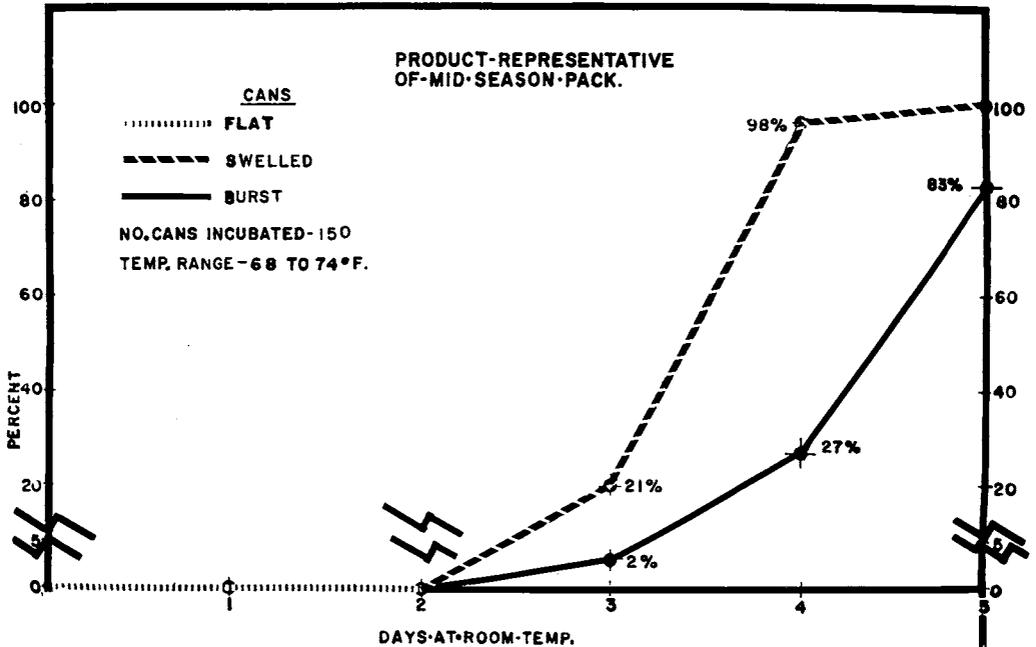


Figure 3. Swells developing at 40°F. in 6 oz. cans of orange concentrate.

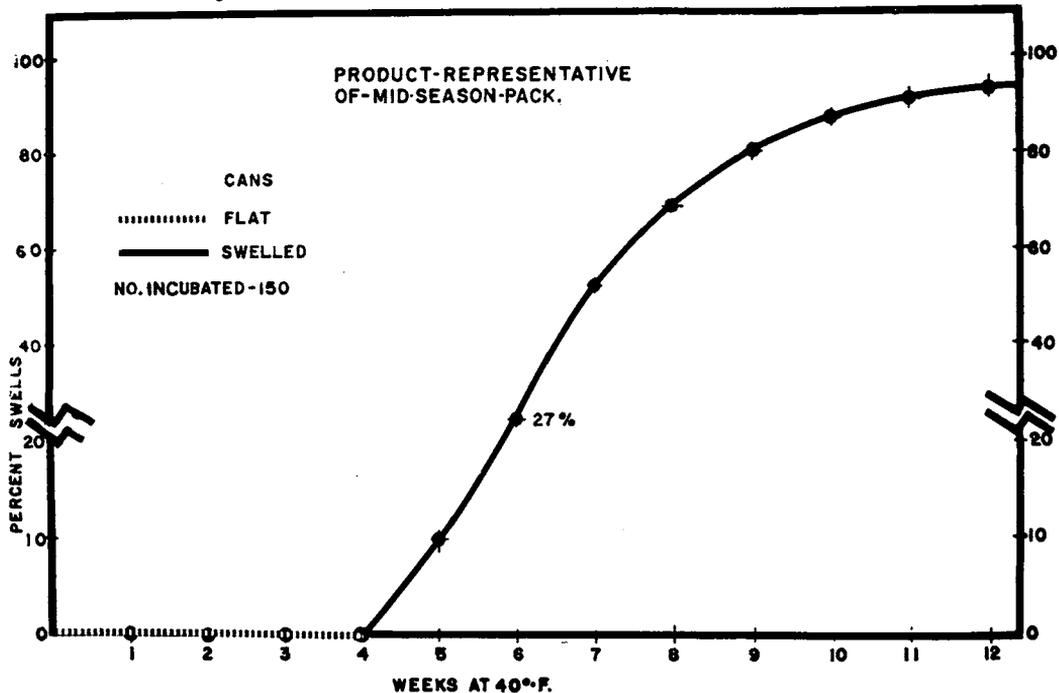
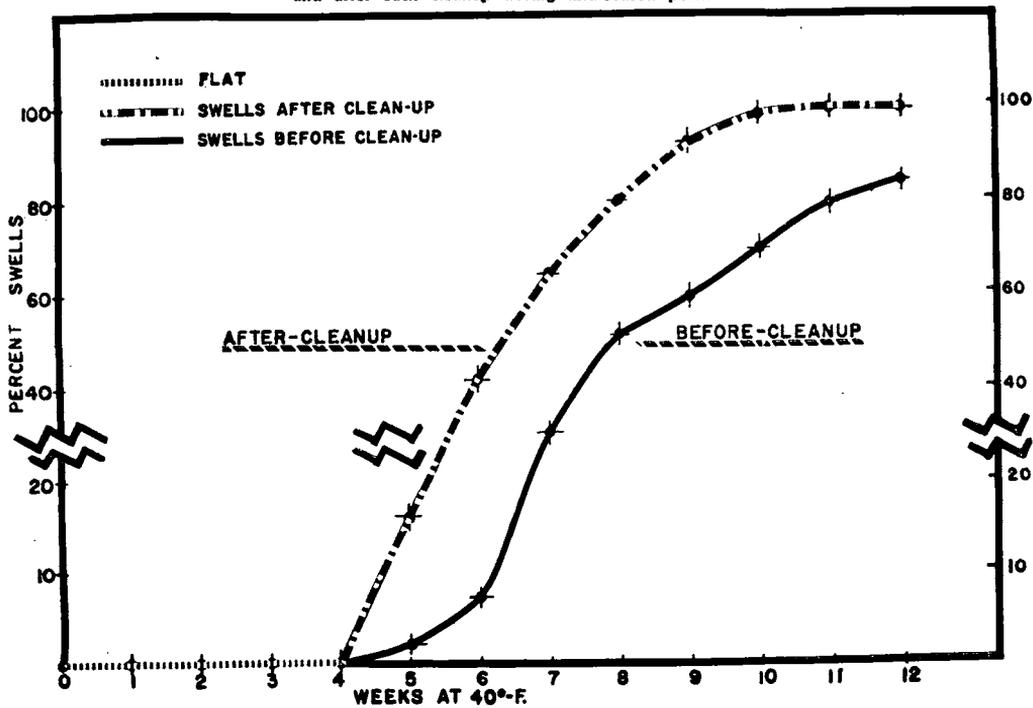


Figure 4. Swells developing at 40°F. in 6 oz. cans of orange concentrate representing product before and after each cleanup during mid-season peak.



and can explosions, and a duplicate group placed at 40°F. to be examined for swells only. Another replicate set of samples was set aside for microbiological examination at each of these two temperatures.

Product held at room temperature for visual examination was checked daily over a 5-day period. In addition, each day during this interval a 10-can sample representative of the entire pack, minus the number that had burst, was plated in duplicate on orange serum agar. Concentrate held at 40°F. was examined weekly for swells, at which time a 10-can cross-sectional sample was also plated; this phase of the experiment was made over a 12-week period.

Results from plant No. 1 were recorded separately from those from plant No. 2. The plates were counted after 72 hours of incubation at 30°C. All counts from each sampling period were converted into logarithms, averaged, and the antilog recorded.

The concentrate used for this study had an average of 41.92° Brix, 2.91% citric acid, and 14.4:1 Brix/acid ratio. The pH ranged from 3.7 to 3.8.

RESULTS AND DISCUSSION

An examination of the data showed that the results from plant No. 1 compared very closely with plant No. 2. Therefore, for sake of brevity the results from each plant have been combined. In describing the condition of cans containing concentrate at room temperature and 40°F., the following nomenclature has been used:

Flat: A normal appearing can with the ends not distended.

Swell: A container with the ends distended. The degree of swelling ranging from a slight bulging up to a point where the ends have become severely extended and/or buckled.

Burst: A can containing concentrate which has exploded (blown up) due to internal pressure (Figure 1).

Spoilage Developing at Room Temperature and 40°F.

Test samples of frozen concentrated orange juice stored at 0 to -10°F. and then placed at room temperature showed no evidence of spoilage at the end of 2 days at which time all cans remained flat. At the end of 3 days 2% of the test samples had exploded and 21% of them had developed into swells. Additional results are shown in Figure 2.

At 40°F., all cans of concentrate at this temperature were still flat after 4 weeks. The cans started to swell between 4 and 5 weeks. This continued until 139 cans out of 150, or 93% were swelled at the end of the 12-week period (Figure 3). Swelled containers were discarded and not checked to determine if they would burst.

In examining the number of swells that developed at both room temperature and 40°F., it was noted that a greater percentage occurred in samples collected after, rather than before, each clean-up. This is shown in Figure 4 for samples held at 40°F. Data show that at the end of 5 weeks 16% of the samples after clean-up were swelled in comparison with only 2% before clean-up; after 12 weeks 99% of the cans after clean-up swelled in comparison with 84% before. This is of extreme interest as one might expect the opposite to be true; i.e., the percentage of cans developing swells would be less after, rather than before, clean-up periods.

Microbiological Data

Growth of microorganisms in concentrated orange juice packed in 6-oz. cans stored at room temperature, representative of the midseason pack, is presented in Figure 5. Data show a steady increase in microbial population from an initial count of less than 1,000 to 600,000 microorganisms per ml. at the end of the 5-day test period.

An examination of Figure 6 shows that microbial population of concentrate held at 40°F. steadily decreased during the first 3 weeks after which a decided increase in microflora occurred. It is interesting to note that the microbial population remained relatively low at 40°F. throughout the test period; even when all of the samples plated were swelled as occurred at the end of 9 weeks. At this time the averaged count obtained from plating a 20-can sample (10 cans from plant No. 1, and 10 cans from plant No. 2) was only 62,000 microorganisms per ml. while 13 of the 20 cans had product counts of 60,000 or less, and 7 cans were higher than this figure. These results indicate that swells can occur in concentrated orange juice with relatively low microbial population.

As previously stated, a greater percentage of swells developed after, rather than before, clean-up periods. A natural assumption would then be that the highest plate counts would also occur from samples plated after a clean-up. To the contrary the opposite was true. Con-

Figure 5. Microbial population in 6 oz. cans of orange concentrate stored at room temperature.

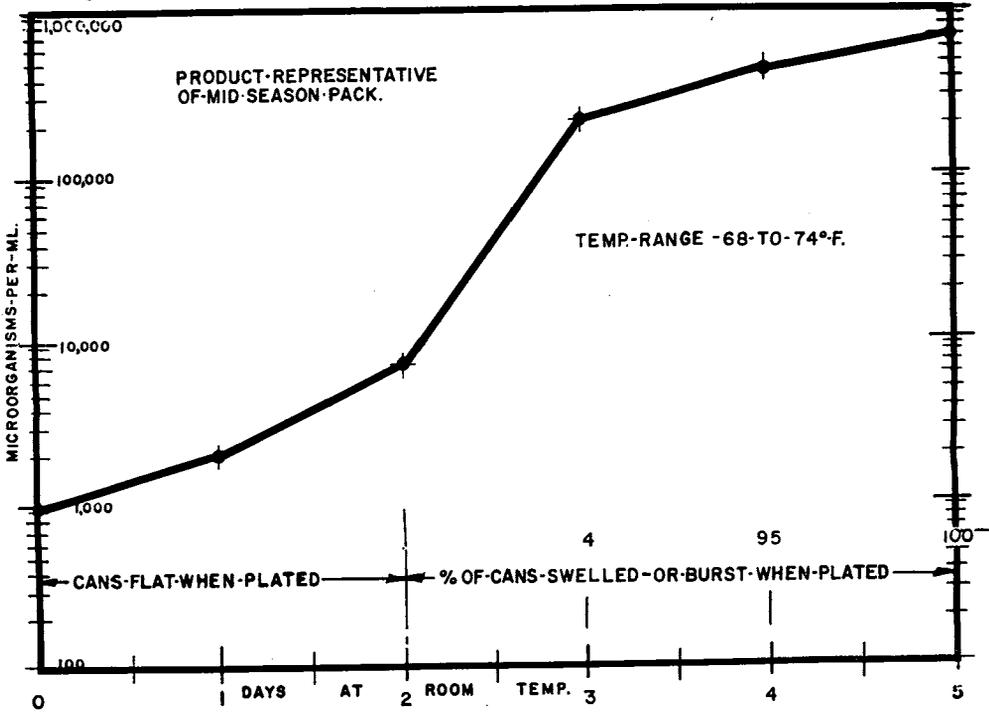


Figure 6. Microbial population in 6 oz. cans of orange concentrate stored at 40°F.

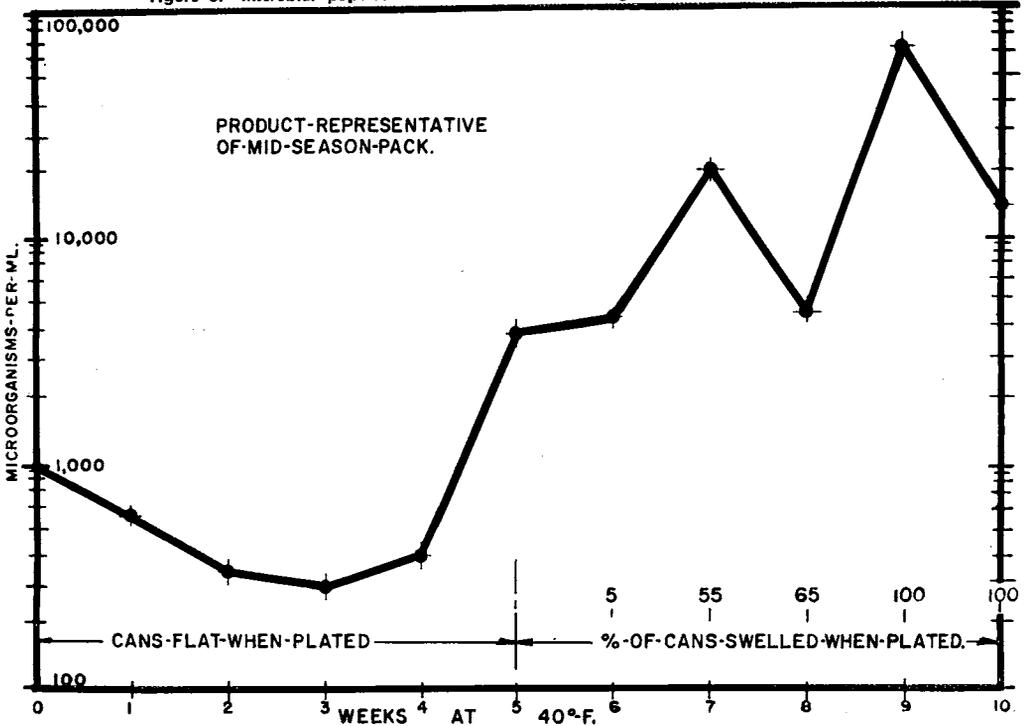
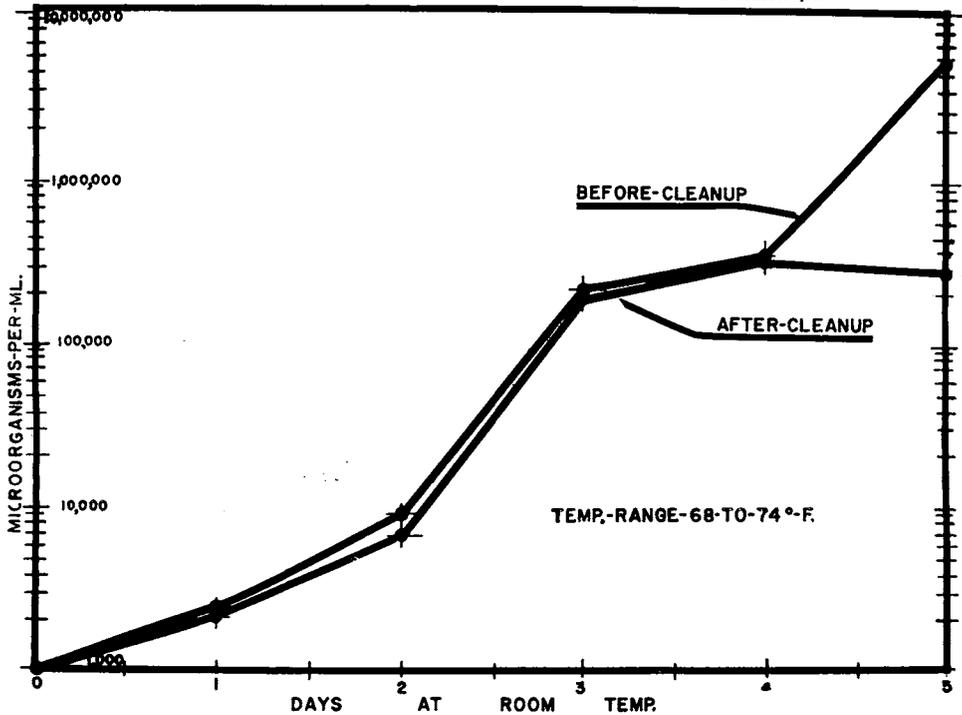


Figure 7. Microbial Population in 6 oz. cans of orange concentrate stored at room temperature representing product before and after each cleanup from midseason pack.



centrate stored at room temperature was found to exhibit slightly lower plate counts through-

out the test period after, rather than before, clean-ups (Figure 7). Generally speaking, similar results (not shown) were also obtained at 40°F. No definite conclusions can be drawn from the data available as to why these conditions exist. However, it is hoped some logical explanation will be forthcoming when samples representative of the Valencia portion of the pack are examined, at which time a detailed study of the microflora present will be made.

It was noted, as would be expected that a mixture of yeast, pin-point and gum-type colonies were present on plates made during the initial phases of the study at both room temperature and 40°F. (Figure 8). Later examinations after 4 days at room temperature and 6 to 8 weeks at 40°F. showed the microflora in the concentrate to be primarily yeast (Figure 8). Similar observations were also made by Edwin L. Moore, et al. (6). These authors reported yeast was the surviving microorganism when frozen concentrate was stored for 2 months at 40°F.

It is evident from the data presented herein that in order for cans of frozen concentrated orange juice to swell and/or explode they must

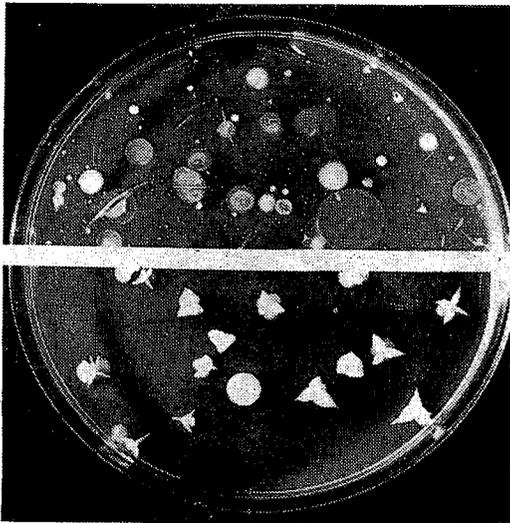


Figure 8. Plate showing colony formation on orange serum agar after 72 hours of incubation at 30°C. (Top) Mixed microflora in concentrate at start of test. (Bottom) Yeast colonies which developed when product held 4 days at room temperature (68-74°F.) was plated.

be held for 4 weeks or more at 40°F.; 3 or more days at room temperature; or intermediate periods at intermediate temperatures. It seems unlikely the consumer would hold product in the refrigerator for such an extended storage period. Therefore, it might be postulated that can swells or explosions when reported by the customer are the result of holding concentrate at temperatures above 40°F.

SUMMARY

Six-ounce cans of frozen concentrated orange juice were collected before and after each clean-up from two plants throughout the midseason portion of the 1960-61 citrus season. Representative samples from each lot were held at both room temperature (68 to 74°F.) and 40°F. Samples were examined visually for swells and can explosions. Total viable counts were also made of the product at periodic intervals throughout the test period.

Product held at room temperature for 2 days showed no signs of spoilage and all cans remained flat at the end of this period. After 3 days at this temperature 21% of the cans had developed into swells and 2% of the cans burst. At the end of 5 days all cans had swelled and 83% of the lot had burst. Product stored at 40°F. showed no evidence of swells at the end of 4 weeks. After 5 weeks, 10% of the samples were swelled, and after 12 weeks this number increased to 93%. Swelled containers were discarded and not checked to determine if they would burst at this temperature. A greater percentage of the samples at both room tem-

perature and 40°F. swelled after, rather than before, clean-up periods.

Concentrates stored at room temperature showed a sharp day-to-day increase in total viable count during the storage period. Plate counts made on product held at 40°F. showed that the microorganisms steadily reduced in numbers up to the 3rd week, after which a pronounced increase in population occurred.

A mixed microflora as evidenced by colony formation was present in the product during the initial phases of the study at both room temperature and 40°F. At the end of the storage period at both of these temperatures predominant flora present in the product were yeast.

These data indicate that in order for cans of frozen concentrated orange juice to swell and/or explode, the product must have received a considerable amount of abuse in terms of temperatures of 40°F. or above.

ACKNOWLEDGMENT

The authors gratefully acknowledge Messrs. T. H. Shang and J. A. Mercer who assisted so capably in performing the analyses.

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HARVESTING SOUTHERN PEAS WITH LESS LABOR

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The southern pea, commonly thought of as the black eye, cream, purple-hull, crowder and speckled pea, have in recent years been taking on new faces thanks to the work of plant breeders throughout the southern states. New varieties with different taste, yield and physical characteristics are now available for commercial production. It is estimated that during the 1959-60 season 6,500 acres with a value of \$1,370,000 were produced commercially in Florida. Indi-

cations are that this acreage is on the increase. A number of produce handlers state that demand for fresh and frozen peas far exceeds the supply throughout the South.

Harvest labor for picking and packing southern peas makes up 59 percent of the labor that goes into production from land preparation to market. It should be pointed out that labor for shelling of peas was not included in this data. Most cannery and frozen peas are machine shelled but labor required to prepare those going to fresh market in shelled form would increase the figure on total labor involved.