FROZEN TEMPLE ORANGE CONCENTRATE[1]

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During the past few years there have been requests by various individuals and companies for information on the use of Temple oranges for the production of a frozen concentrate with characteristic Temple flavor. The Temple orange is probably a natural hybrid between a sweet orange and some variety of mandarin. Hume (3) and Robinson (6) discussed the origin of the Temple orange.

This report contains pertinent information obtained from the examination of experimental packs of Temple orange concentrates. The first lot of fruit was processed in March, 1950, followed by packs prepared during the 1951-52 and 1952-53 seasons.

EXPERIMENTAL PROCEDURE

Preparation of Packs. The lots of fruit were thoroughly washed and the juices extracted using either a Rotary or a Citro-Mat extractor. The juices were finished by passing through a Food Machinery finisher (Model 35) equipped with a 0.030 inch perforated screen. These juices were concentrated using a low-temperature pilot plant evaporator (1) and then cut-back juices, containing varying amounts of pulp, were added to obtain the final desired products. In some cases the juice fraction from the scraper blade on the Citro-Mat extractor was added to the cut-back juice or else cold-pressed peel oil was added directly to the concentrate. The concentrates were filled into 6 oz. cans, vacuum closed, and stored at −8° F.

Analytical Methods. The pectinesterase activity in the Temple concentrates was determined essentially by the method described by MacDonnell, Jansen, and Lineweaver (4), using a Beckman Model K Automatic Titrator. Pectinesterase units (PE.u.) were expressed as the milliequivalents of ester hydrolyzed per minute per gram of soluble solids (° Brix), and multiplied by 1000 for easy interpretation. Clarification was measured by percentage light transmission of the centrifuged reconstituted juices, using a 10 mm. rectangular cell and Filter No. 730 in a Lumetron colorimeter. Gelation in the concentrates was checked according to a method described by Olsen, Huggart, and Asbell (5). The pulp content of the reconstituted concentrates was obtained by the centrifugal method. Oil determinations were made on reconstituted juices using the Clevenger apparatus as prescribed for U.S.D.A. standards (7). One series of oil determinations was made by the American Can Company in Tampa with their modified oil recovery apparatus.

EXPERIMENTAL RESULTS AND DISCUSSION

For brevity, in Table 1 data are shown for only seven of the 13 packs prepared. The Brix/acid ratio was relatively low with a correspondingly low pH. Also, as in the case of tangerine concentrates (8), the final pulp content was low. In one sample, 75 percent of the volume of cut-back juice used was pulp and still it had a low pulp content, as compared to orange concentrate made in a similar manner. The total microbiological count, using dextrose agar at pH 7.0, in two of the freshly extracted Temple orange juices was 24,000 and 39,500 per milliliter.

It may be seen from Table 2 that the pectinesterase activity, ranging from 0.0013 to 0.0076 PE.u. was relatively low when compared to orange concentrates but was similar to that found in tangerine concentrates (8). As was expected, when the pulp content was increased in the four packs processed on April 24 by increasing the pulp content in the cut-back juices, the pectinesterase activity similarly increased. Upon standing for 24 hr. at 80° F., the clarification in the products also increased in proportion to pulp content. These data are in line with similar results (5) reported for orange and grapefruit concentrates. It may be noted that the degree of gelation obtained after storing the concentrates for 24 hr. at 80° F. was only very slight and of no consumer significance.

The first packs were made by following the same procedures as those employed in the production of orange concentrate. These

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Table 1

Experimental packs of frozen Temple orange concentrates

Date processed	Concentrate				Reconstituted juice	
	Brix 28°C.	Acid %	Brix/acid ratio	pH	Pulp % by vol.	Recoverable oil % by vol.
1-15-52	42.5	4.89	8.7	3.1	5.0	Trace
3- 5-52	43.9	3.44	12.8	3.4	5.0	Trace
3-14-52	42.5	3.46	12.3	3.5	5.0	Trace
4-24-53 (A)	45.6	4.01	11.4	3.3	3.0	.007
4-24-53 (B)	45.4	4.00	11.4	3.3	4.0	.007
4-24-53 (C)	45.4	4.00	11.4	3.3	4.5	.011
4-24-53 (D)	45.6	4.08	11.2	3.3	5.0	.011

packs were of good flavor but lacked the characteristic Temple orange flavor. To impart this typical Temple flavor, in one pack the juice fraction obtained from the scraper blade of the Citro-Mat extractor was added to the cut-back juice. This imparted only a slight Temple flavor although the reconstituted juice had a 0.024 percent by volume recoverable oil content. It may be possible to obtain Temple flavor of greater intensity by adding more of this juice fraction or by using another lot of fruit.

Another method employed for oil addition was that of adding hand-pressed oil from peel from the Rotary press. This yielded a product having a 0.032 percent oil content and a definite Temple flavor, but this method would be difficult to control for duplication and ob-

Table 2

Clarification and gelation in Temple orange concentrates

Date processed	Pulp % by vol.	Pectinesterase activity (PE.u.)[b]	Degree of clarification[c]		Degree of gelation	
			Initial	After 24 hr. at 80°F.	Initial	After 24 hr. at 80°F.
1-15-52	5.0	3.0	55-None	79-Definite	None	Very slight
3- 5-52	5.0	4.6	55-None	91-Extreme	None	Very slight
3-14-52	5.0	7.6	57-None	94-Extreme	None	Very slight
4-24-53 (A)	3.0	1.3	53-None	68-Slight	None	None
4-24-53 (B)	4.0	2.3	52-None	82-Definite	None	None
4-24-53 (C)	4.5	3.9	51-None	91-Extreme	None	None
4-24-53 (D)	5.0	4.6	50-None	92-Extreme	None	Very slight

[b] Pectinesterase units (PE.u.) per gram soluble solids x 1000. Soluble solids measured by refractometer at 28°C. as °Brix.

[c] Clarification measured by percentage light transmission of centrifuged reconstituted juice using 10 mm. rectangular cell in Lumetron colorimeter with Filter No. 730. Degree of clarification: 0 - 59% = none; 60 - 69% = slight; 70 - 84% = definite; 85 - 100% = extreme.

Table 3

Intensity of Temple flavor in reconstituted concentrates with different oil levels

Temple flavor	Definite[d]	Slight	None
Recoverable oil range-%	.007 to .032	Trace to .024	Trace to .010

[d] All samples in this group had cold-pressed peel oil added.

viously not practical. Cold-pressed Temple oil, prepared using a Fraser-Brace extractor, was added to four concentrates (42 ml. oil to 13.75 gal. of concentrate), packed on April 24, to bring the oil level to about 0.020 percent. These products had a definite Temple flavor, but upon analysis results indicated an oil content ranging from only 0.007 to 0.011 percent. This brought out the fact that the percentage of oil in a Temple concentrate, as indicated by the Clevenger method, might not show a direct relationship to the intensity of Temple flavor in the product. Data in Table 3 readily show this fact, since it can be seen at a glance that there was a wide overlapping of oil content as compared to Temple flavor. It is believed that the oil content is one of the main factors responsible for the Temple flavor in the concentrate; however, since results did not bear this out, it was thought advisable to check the oil determinations, because it had been observed previously that the Clevenger method did not give complete oil recovery.

Four packs of Temple concentrate were sent to the American Can Company in Tampa for oil determinations by their modified oil recovery apparatus. The data in Table 4 show the results obtained. It may be seen that, although their results were closer to the calculated amount present, there was still a considerable amount of oil not recovered. As a further check, a sample of Temple concentrate was divided into two portions and 0.021 percent oil by volume added to one portion. Both samples were then stirred for 30 min. after which they were transferred to Clevenger flasks and water added. The oil obtained from the sample to which 0.021 percent oil had been added was only 0.013 percent and only a trace of oil was recovered from the control sample. It might be well to mention that Curl (2) performed similar experiments using pure limonene as added oil and reported an average loss of 0.07 ml. per recovery regardless of total amount of limonene used.

Results obtained in this study very clearly indicated that initially the processor can only use flavor as a criterion in establishing his methods for the manufacture of Temple concentrate. However, it may be possible that

Table 4

Recoverable oil from reconstituted Temple orange concentrates

Date processed	Oil recovered-% by vol.		Added cold-pressed peel oil % by vol.	Pulp % by vol.
	Clevenger method	American Can Co. method[e]		
4-24-53 (A)	.007	.014	.020	3.0
4-24-53 (B)	.007	.015	.020	4.0
4-24-53 (C)	.011	.015	.020	4.5
4-24-53 (D)	.011	.015	.020	5.0

[e] Analyses made by American Can Co. with modified oil recovery apparatus.

with a fixed procedure oil determinations and flavor could be correlated.

SUMMARY

Thirteen packs of frozen Temple orange concentrates were prepared during three seasons, all of which were products of good quality. However, a concentrate with the typical Temple flavor was obtained only when cold-pressed peel oil from the fruit was added to the concentrate. The intensity of Temple flavor did not correlate directly with the recoverable oil content of the concentrates, since oil determinations showed little relationship to the characteristic Temple flavor.

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THE RESULTS OF RESEARCH ON CITRUS PROCESSING WASTE DISPOSAL

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The value of citrus fruit and citrus processing to Florida is probably better known to this audience than to the writer. However, a few statistics may help to remind us of the magnitude of the industry.

During the crop year 1952-53, Florida produced 109,600,000 standard boxes of citrus fruit valued at $218,828,993. Of that amount 62,000,396 boxes of fruit were consumed by processing into juice, sections, concentrate, fruit salad, etc. In other words, processing plants used just slightly over 50 percent of all the citrus fruit picked that year. It was estimated that the gross value of the processed fruit at the canner's door was $86,857,519.00. Needless to say, all Florida has a stake in those figures.[1]

However, the processing of citrus fruit can produce a liability as well as an asset. I refer, of course, to the waste products which flow just as steadily into the streams and lakes of Florida as the golden fruit flows into the chutes of the processing plants. Much has been done since citrus canning first started in 1921 to reduce or eliminate wastes of various kinds and by-products of cow feed, citrus molasses, peel oil, alcohol, pectin, are ample evidence of the ingenuity and technical skill of the American industrialist and his staff of experts as they constantly strive to leave not even the "squeal" in the case of citrus fruit. There does remain, though, in spite of their efforts, a residual of dissolved sugars and a small amount of suspended solids in the huge volumes of process water which ultimately, up to now, has found its way into the surface and underground streams. This residual probably seems to a person used to thinking in terms of per cent or brix to be too slight to deserve consideration. The quantities in many cases are so slight that they are expressed in parts per million by weight; however, these slight residuals may make one good-sized concentrating plant the equivalent in terms of organic content to a city of many thousands of persons.

The sanitary engineer or sanitary chemist expresses the polluting potential of a waste in