tested cost more than the current price of the citrus colorimeter. The Agtron is substantially cheaper. However, the model tested here does not have output capability, so the color number equation must be solved manually. A new model, which will allow for preprogrammed equations, will be available by the time this article appears in print. The Hunterlab instruments used all have output capability.

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FLORIDA CANNERS RECOVERY FROM 1971-72 THROUGH 1976-77 AND RECOMMENDATIONS FOR FUTURE REGULATIONS

J. T. Griffiths and William J. Hepburn
Florida Citrus Mutual,
P. O. Box 89, Lakeland, Florida 33802

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Abstract. **The 6 years from 1971-72 through 1976-77 are analyzed according to reports from the Florida Canners Association and the Florida State Inspection Service to demonstrate the percentage recovery which canners were able to obtain as compared with the volume of juice or pounds solids reported to the grower. In addition, the amount of pulp washed solids for concentrate produced during those periods is compared with the amount of frozen concentrated orange juice produced. It is recommended that the canner tolerance of 102% can be reduced to 101% and that 3 weeks average recoveries as reported by canners form the basis for an objective test to trigger raising or lowering the testhouse extractor factor.**

In 1971, Griffiths (1) presented a paper covering results for the period from 1963 through 1971 on orange juice yields which had resulted from instituting a quality improvement program with substantial restrictions on canner recovery.

During the 1968-69 season the testhouse procedure was further modified by installing identical extractor and sampling procedures in all processing plants. The testhouse extractors were set to operate at 45 pounds of extractor pressure. This pressure resulted in the over extraction of the oranges and yielded something besides good, usable juice. Therefore, it was necessary to factor the results in terms of what was reported to the grower. In the initial stages, the canners were permitted to have a tolerance of 5% extra recovery over that reported to growers. This was modified in 1969-70 to 4%, and then in 1970-71 to 2%. The individual processor had to stay within the tolerance limit on a seasonal basis. Thus, he had to average less than 102% over the entire season, and could exceed 102% only for a limited number of weeks in sequence.

Comparisons of juice in oranges as reported by the Statistical Reporting Service on April 1st and then compared with the actual juice recovered by canners showed that the period from 1968 through 1971, as a result of the testhouse program, did result in substantially reduced yields by canners. The sales pattern and consumer response clearly indicated a substantial improvement in orange juice quality.

Griffiths (1) recommended that the recovery by canners should be reduced from 102% to 101% and he suggested specific correction factors by dates. These recommendations were never acted upon by the industry.

In the 1972-73 season, a further modification was made to require that the 102% recovery figure be calculated separately for early-midseason oranges for the period ending on approximately April 1st. The 'Valencia' period was also restricted to 102% for the balance of the season.

Current regulations permit a canner to recover over 104% in any one week, but in any 3 week period, the average must be below 104%. Actually, a canner can recover 103.9% on a continuing basis for a considerable period of time provided only that the average for that variety does not exceed 102%.

The factor for determining the juice yield to be reported to growers is recommended by a testhouse extractor committee composed of 2 representatives each from the Florida Citrus Commission, the Florida Canners Association, Florida Citrus Mutual, intermediate handlers, and Florida Citrus Packers. The committee meets on call of

the chairman and attempts to modify factor settings as the season progresses to permit the recovery of good, usable juice throughout the season. However, because the committee has to operate on the basis of subjective judgments, there have been occasions when factors have been lowered or raised too much and corrections had to be made almost *immediately.*

In general, there has been a tendency for factors to start at 85% or 86% and rise to either 88% or 89% for early-midseason oranges. In the case of 'Valencias' the tendency has been for the factor to rise from no lower than 89% to no higher than 91% during the 'Valencia' season.

Following the freeze in January, 1977, the factors were substantially lowered by comparison with other years. In addition, the canners recovered a lower percentage of the permitted juice than in any of the preceding 5 years. This is a clear indication that, on the average, canners are willing to get a lower percentage recovery than permitted by regulation in order to maintain quality. This represents self-regulation and not mandatory regulation. The program instituted after the freeze resulted in the maintenance of quality of the orange juice packed.

The State Inspection Service issues reports weekly on the number of plants that exceed 99, 100, 101, etc. percent recovery, but they do not publish an average percentage recovery for each week.

The Florida Canners Association does report each week on average weighted percentage recovery for all canner members and they show the average recovery, season to date. This report is usually received on Friday or Saturday for the preceding week.

Results and Discussion

Table 1 shows that, in general, the recovery for orange concentrate (FCOJ) only is higher than for the overall processed orange juice products. It has been recognized for many years that it is much more difficult to obtain maximum recovery on single strength juice products than on frozen concentrate. In general, the canners show an average recovery of around 1½% more than was reported to the grower insofar as concentrate is concerned and about 1% overall on all juice products.

At the present time and for the last number of years, pulp washed solids have not been allowed in any product except concentrate for manufacture. However, pulp washed solids are being produced by most processors and represent about 2.4% additional solids recovery. In general, pulp washing has been increasing throughout the 6 year period, both as a percentage of the frozen concentrated orange juice pack and also as total gallons of product. However, the gallons of pulp washed solids decreased as the result of the shortened crop following the freeze losses in January, 1977.

Table 1 indicates that canners are generally able to recover, as concentrate, between 88% and 89% of the solids extracted at 45 pounds testhouse pressure for early-midseason oranges and usually more than 91% on 'Valencias.' Thus, the 101.06% recovered as concentrate by the canners on early-midseason oranges in 1976-77 represented 87.31% of the solids extracted at 45 pounds pressure. When *the pulp* washed solids were added to the recovery, the canners recovered 103.89% of the solids reported to the grower and 89.78% of the actual solids extracted at 45 pounds pressure. Pulp washed solids usually added about 2% on earlies and mids and more than 3% on 'Valencia' oranges.

Recommendations

An analysis of the canner recovery clearly indicates that the 2% tolerance is not required in order for the canner to maintain a legal recovery situation. A 1% override would be adequate and probably a half of 1% would be satisfactory. It must be remembered that this percentage override is based on a prolonged period of time and represents only an average. Thus, if the recovery tolerance were reduced from 102% to 101% or even to 100.5% and the factor increased by 1 percentage point, the processor would be operating on essentially the same basis as today, recovering the same amount of total product, but instead of staying between 101% and 102%, the canner would operate between 100% and 101%.

Today, the testhouse extractor committee makes factor changes on the basis of informed, but subjective judgments. It is quite possible to set up an objective basis which would force the factor to go up or down depending upon the actual recovery of the canner. Under such a recommenda-

Table 1. A comparison of the recovery of FCOJ, pulp washed solids, and overall canner percent recovery.

Var.	Season	Week ending E & M	Gals. 45°Brix conc. FCOJ[z] (000)	Gals. 45°Brix conc. Pulp wash[y] (000)	% Recovery FCA[x] all	% Recovery FCOJ[w]	% Recovery Pulp wash[v]	% Recovery FCOJ+ pulp wash	% of testhouse recovered[u] FCOJ	% of testhouse recovered[u] FCOJ+ pulp wash
Early and Midseason	76-77	3/12	98,831	2,798	100.61	101.06	2.83	103.89	87.31	89.78
	75-76	3/26	104,636	2,803	101.30	101.55	2.68	104.23	89.52	91.92
	74-75	3/29	99,151	3,681	101.54	101.78	3.71	105.49	88.22	91.49
	73-74	3/30	95,927	1,889	101.27	101.43	1.97	103.40	88.13	89.87
	72-73	4/7	91,670	1,666	100.68	101.16	1.82	102.98	87.86	89.46
	71-72	3/25	67,374	911	100.72	101.34	1.35	102.89	88.11	89.30
Valencias	76-77		59,204	2,687	100.34	101.03	4.54	105.57	88.19	92.43
	75-76		81,628	3,090	101.03	101.58	3.79	105.37	91.57	95.04
	74-75		79,023	2,625	101.01	101.59	3.32	104.81	91.63	94.67
	73-74		57,918	2,019	100.93	101.19	2.66	103.85	90.66	93.07
	72-73		84,403	1,813	100.61	101.17	2.15	103.32	91.34	93.30
	71-72		66,855	1,911	100.90	101.79	2.86	104.65	92.20	94.84

[z]Reported by Florida Canners Association.
[y]Reported by State Inspection Service.
[x]Recovery of all juice products reported by Florida Canners Association.
[w]Calculated by dividing pounds solids recovered by pounds solids reported to grower from Florida Canners Association reports.
[v]Gallons of pulp wash divided by gallons of FCOJ produced.
[u]Calculated by multiplying the percent pounds solids recovered each week times the testhouse recovery factor for that week and averaged for the season.

tion, it is believed that the testhouse committee should have the authority to modify any change dictated by such an objective method to be certain that substantial errors were not made or new problems created, but an analysis of the past 6 years indicates that the recommended rules would have worked satisfactorily.

Therefore, it is recommended that the following proposal be given serious consideration by the industry and it, or some modification thereof, be adopted so that changes are made on an objective basis and are subject only to review by the testhouse committee.

When the last 6 years were calculated on this basis, it was determined that the changes would be more gradual and would result usually in only 1 percentage point change in a week. The recovery during the season would move smoothly from early and midseason oranges into 'Valencias.' The problems resulting from the freeze of 1977 were satisfactorily accounted for. In general, the factor would increase or decrease at about the same time as had been recommended by the committee. Table 2 shows the results of this procedure as they would have occurred during the 1976-77 season.

Table 2. A comparison of actual factors and percent recovery by canners with factors and percent recoveries resulting from recommended changes based on three week rolling averages for the 1976-77 season.

Column	1	2	3	4	5	6
	Actual		% of	Theoretical		
Week	% Factor	FCA % Recovery	Juice at 45# (1 x 2)[z]	% Factor	% Recovery (3 ÷ 4)[y]	3 Week Average[x]
1	86	100.19	86.16	86	100.16	
2	86	91.45	78.65	86	78.65	
3	86	98.60	84.80	86	98.60	
4	86	100.02	86.02	86	100.02	
5	86	98.59	84.79	86	98.59	
6	86	99.63	85.68	86	99.63	
7	86	100.27	86.23	86	100.27	
8	86	100.36	86.31	86	100.36	
9	86	101.23	87.05	86	101.23	100.62
10	86	101.87	87.60	86	101.87	101.15
11	86	101.85	87.59	86	101.85	101.65
12	86	101.48	87.27	87*	100.31	101.34
13	86	102.64	88.27	87*	101.46	101.20
14	86	100.66	86.57	87*	99.50	100.42
15	87	101.54	88.34	88*	100.38	100.45
16	87	100.38	87.33	88*	99.23	99.70
17	87	100.35	87.30	88*	99.20	99.60
18	87	101.51	88.31	87	101.51	99.98
19	86	100.84	86.72	87*	99.67	100.13
20	86	99.98	85.97	87*	98.82	100.00
21	86	98.84	85.00	87*	97.70	98.73
22	86	99.03	85.17	87*	97.89	98.14
23	86	99.11	85.23	86	99.11	98.23
24	86	99.34	85.43	86	99.34	98.78
25	86	99.83	85.85	86	99.83	99.43
26	86	102.11	87.81	86	102.11	100.42
27	86	100.60	86.52	86	100.60	100.85
28	88	100.97	88.85	86*	103.31	102.01
29	88	100.53	88.47	86*	102.87	102.26
30	88	99.67	87.71	88	99.67	101.95
31	88	99.93	87.94	88*	99.93	100.82
32	88	100.06	88.05	89*	98.93	99.51
33	88	99.84	87.86	89*	98.71	99.19
34	88	99.79	87.82	88	99.79	99.14
35	88	101.28	89.13	87*	102.44	100.31
36	88	100.57	88.50	87*	101.72	101.31
37	88	100.57	88.50	87*	101.72	101.96
38	88	99.88	87.89	88	99.88	101.10

[z]This is the percentage of juice actually recovered compared with that juice squeezed at 45 pounds pressure in the testhouse.
[y]This is calculated by dividing the percentage recovery in columns 3 with the factor in effect for that week.
[x]The weekly recoveries in column 2 are added together and each three week period average is determined for the week ending as indicated in column 6.
*Change from actual.

Under the recommended procedure the override tolerance for the canner would be reduced from 102% to 101%. Thus, if in the past the factor for reporting juice to the growers was set at 86%, it would now be set at 87% and the canner would be allowed to recover 101% of that 87%; or 87.87% of the juice extracted at 45 pounds pressure in the testhouse.

1. The initial factor on early-midseason oranges shall be 86% (equivalent to 85% under the present system), and this shall remain in effect from the beginning of the season until the week containing the first Monday in December.

2. Factors for early-midseason oranges shall not be higher than 90% or lower than 86%.

3. Factors for 'Valencia' oranges shall not be higher than 92% or lower than 86%.

4. The first Monday in April should represent the break between early-midseason oranges and 'Valencias.' Prior to that date, the factor could not exceed 89% and after that date shall not exceed 92% as noted in paragraphs 1, 2 and 3.

5. Recovery factors for calculating three week averages for the early-midseason period shall commence with the three reporting weeks in November, week numbers 5, 6 and 7. Thus, the first change that could take place would be week number 9 or the first week in December.

6. During the season, factors shall be moved up or down or remain the same, based on the average of the last 3 reporting weeks and based on the weekly reported yield for all products as listed by the Florida Canners Association.

a. For purposes of these rules, weeks associated with a change in the testhouse factor shall be designated as follows:
   (1) W–1—This is the trigger week and is the week in which the 3 week average is either below 100.00% or above 100.99%.
   (2) W–2—This is the week following W–1, and is the week in which it is determined on a Thursday or a Friday that the 3 week average calculated for the 3 weeks ending in W–1 triggers a change in the factor. The factor is the same as during W–1.
   (3) W–3—This is the week in which the new factor is first put into effect. It is the second week after W–1.
   (4) W–4—This is the week following the week in which the change in the factor was first made. The factor will usually, but not always, be the same as the W–3 factor.

b. Since the report and the 3 week calculation can be made only by Thursday or Friday (of W–2 week) for the preceding week (W–1), the net result is that there has been a continued week (W–2) at the original percentage factor, and then a new percentage is set for the following week (W–3). Thus, if the percentage factor had been 87 on early and mids and the average for the 3 week period ending in W–1 as determined by Friday (of W–2) was 99.5%, the week (W–2) in which the actual calculation was made would have remained at 87%, but the following week (W–3) would be reduced to 86%.

c. If the weekly average is between 100 and 100.99%, no change occurs in the factor.

d. If the 3 week average (W–1) is between 99.00%

and 99.99%, the following week (W–3) shall be reduced by 1 percentage point.

e. If the average recovery in W–1 is 98.99% or lower, a 2 point reduction would take place the following week (W–3).

f. If the 3 week average (W–1) is between 101.00% and 101.99%, there would be a one point increase the following week (W–3).

g. If the 3 week average (W–1) is between 102.00% and 102.99%, there would be a 2 point increase the following week (W–3).

h. If the average (W–1) was higher than 103%, there would be a 3 point increase the following week (W–3).

7. When a change has been indicated by a calculation on a Friday (W–2) for the following Monday (W–3), the calculation for the 3 week period ending with the week (W–2) in which the triggering percentage had been calculated (W–2) would trigger changes in the following manner as opposed to those point changes reported in paragraph 6 above.

a. If the factor had gone down in W–3; then
   (1) 99.00% to 100.99% average in W–2 would result in no change in W–4.
   (2) Less than 98.99% average in week W–2 would lower 1 additional point for week W–4 as compared with week W–3.

b. If the factor had gone up in W–3; then
   (1) 100.00% to 101.99% average would cause no change in W–4.
   (2) 102.00% to 102.99% average would increase W–4 by 1 point over W–3.
   (3) 103.00% or higher average would increase W–4 by 2 points as compared with W–3.

8. During the first week (W–3) when a new factor has been put into effect, the 3 week calculation ending with that week (W–3) will result in the following changes as compared with paragraphs 6 or 7 above.

a. If the factor had gone down 1 point in W–3 as compared with W–2; then
   (1) 99.00% to 100.99% average would result in no change in the week after W–4.
   (2) 98.99% average or less in W–3 would lower 1 additional point in the week after W–4.

b. If the factor had gone down 2 points in W–3, then the 3 week average for W–3 would trigger succeeding changes in the same manner as in paragraph 6.

c. If the factor had gone up 1 point in W–3; then
   (1) 100.00% to 101.99% would result in no change in the week after W–4.
   (2) 102.00% to 102.99% would increase by 1 point the factor in the week after W–4.
   (3) 103.00% or higher would increase the week after W–4 by 2 points.

d. If the factor had gone up 2 points in W–3, the same triggering mechanism would be in effect as found in paragraph 6.

9. During the week following a change (W–4) after a new factor has been put into effect, the rules in paragraph 6 for changes would be in effect.

Conclusions

The testhouse extractor program regulations have resulted in canners obtaining about 1½% more than the gallons of juice or pounds solids reported to growers.

Since canners have been able to maintain legal tolerances between 101 and 102%, it is concluded that the factor in the testhouse should be raised by 1 point and the canner tolerance reduced from 102% to 101%.

Pulp washed solids have been increasing both as the percentage of concentrate pack and in terms of actual gallons over the six year period.

Raising the percentage factor for growers by 1% and decreasing the canner tolerance from 102% to 101% would permit the canner to operate slightly above a 100% recovery factor as compared with the juice or pounds solids reported to the grower.

By using 3 week averages for the canners' reported recovery figures, it is possible to set up a system which automatically triggers raising or lowering the recovery factor without the necessity for the testhouse extractor committee meeting. This would provide a smoother transition from one level to another than is currently in effect.

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