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RCSA 1994-1995 MINI-GRANT FINAL REPORT

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Center: Viticulture & Enology Research Center

Project Title: Fruit Juice Adulteration: Analytical Methods For Low Levels of Sorbitol

Principal Investigators: Barry H. Gump
Katherine G. Haight

Milestones to be reached:

1. High Performance Liquid Chromatography [HPLC] procedure resolving two fruit juice carbohydrate problems 1) sucrose hydrolyzes at high temperatures under acidic conditions 2) sorbitol chelates with fructose and can not be quantitated at low temperatures.
2. A "carbohydrate profile" database will be prepared on fruit juice values resulting from this new method.

Justification:

The adulteration of fruit juice beverages is a serious economic problem with considerable international regulatory complications. The incentive to adulterate fruit juices is enormous, with the potential for illegal profits running into the millions of dollars. Adulteration of fruit juices has progressed from simple dilutions with water and the substitution of cheaper ingredients to very sophisticated methods using "chemical cocktails" designed to mask the adulteration process. The struggle against juice adulterators is never ending; it is a classic example of how the scientific developments used to detect adulteration become the current science of the adulterator in designing further illegal schemes.

California has three large, new [less than five years old] apple processing plants for juice concentrate. At times it is necessary for them to buy apple juice concentrate for blending into their final products. These plants need to know -to satisfy their own customers- that the concentrate they buy is not adulterated.

It is our goal to be recognized throughout the fruit juice industry as a research facility capable of solving their production problems. A significant problem for any juice producer is assuring the authenticity of their products. This project allowed us to acquire the laboratory skill to be able to perform another analysis included in authenticity/certification services for potential clients.

Narrative description of overall activities, and accomplishments:

The effectiveness of determining the amount of dilution is limited by the natural variation in sorbitol content. Brause et al. (1986) suggested an acceptable sorbitol range of 0.03 - 0.12 g/Kg of apples. Very limited data has been reported, however, sorbitol-total carbohydrate ratios may range from 0.0166 to 0.0962 in apples grown in the United States. Differences would be expected from region to region or state to state.

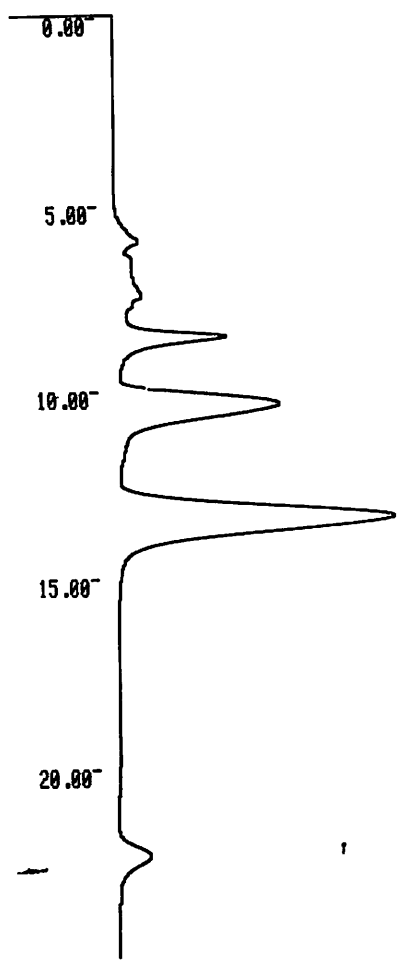
The appended spread sheet reveals sugar profiles for various varieties of apples, peach, and carrot juice concentrates primarily grown in the San Joaquin Valley. This database will be the basis for future fruit juice sample comparisons. The data suggest no sorbitol in the carrot juice concentrate samples. The peach juice concentrate disclosed a relatively small amount of sorbitol, with a sorbitol/ total carbohydrate ratio of 0.01. All varieties of apple juice concentrates had a sorbitol/ total carbohydrate ratio between 0.03 and 0.04. This range is within the values indicated in our proposal.

Appended are sugar profile chromatograms of two apple juice concentrates, and a chromatogram of one of the standards used in this project. Presently we have two graduate students trained on this analysis, and we have an instrument currently dedicated for sugar analyses.

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LAB ID	DATE RECEIVED	SAMPLE DESCRIPTION	SORBITOL [g/100g]	SUCROSE [g/100g]	GLUCOSE [g/100g]	FRUCTOSE [g/100g]	TOTAL SUGAR [g/100g]	TOTAL CARBOH. RATIO
MW94100	9/21/94	APPLE CONCENTRATE	2.38	6.96	16.66	37.22	63.22	0.04
MW94101	10/4/94	100% GALA, CLEAR	1.87	10.99	10.93	34.44	58.23	0.03
MW94102	10/4/94	100% GRANNY SMITH	1.67	5.71	19.45	31.82	58.66	0.03
MW94103	10-4-94	100% GALA (CLOUDY)	1.59	13.93	10.40	32.97	58.90	0.03
MW94104	10-4-94	APPLE CONC	1.82	4.53	19.80	32.26	58.41	0.03
MW 94105	10-4-94	70% MWA FUJI + 30% WA FRONTIER-	2.29	6.59	17.56	33.59	60.03	0.04
MW 94106	10-4-94	APPLE CONC.; S#502						
MW94107	10/11/94	CARROT	0.00	0.00	0.00	0.00	0.00	
MW94108	10/17/94	100% GRANNY SMITH; S# 4						
MW94109	10-20-94	100% GRANNY SMITH; APPLE CONC.	1.94	1.54	18.86	31.84	54.19	0.04
MW 94110	10-20-94	100% FUJI; APPLE CONC.	2.38	5.23	17.99	35.12	60.71	0.04
MW 94111	10-20-94	PEACH JUICE CONC.	0.69	23.73	13.48	14.97	52.87	0.01
MW 94112	10-20-94	APPLE JUICE CONC.	1.87	4.40	18.28	34.85	59.40	0.03
MW94113	10/27/94	100% GRANNY SMITH;EVAPORATOR	1.94	6.73	18.50	35.04	62.21	0.03
MW94114	10/27/94	FUGI AND REWORK	2.54	5.14	17.81	34.69	60.17	0.04
MW94115	10/27/94	GRANNY SMITH/MIX	2.06	5.12	16.72	30.83	54.74	0.04
MW94116	11/17/94	GRANNY SMITH/MIX	1.66	5.29	18.80	32.40	58.15	0.03
MW94117	11/17/94	FUJI	2.22	4.64	16.65	33.46	56.98	0.04
MW94118	11/17/94	APPLE CONCENTRATE	2.07	5.40	18.91	35.11	61.50	0.03
MW94119	11/22/94	CARROT JUICE						
MW94120	11/23/94	CARROT CONC. AFTER PASTURIZATI	0.00	15.84	2.89	3.41	22.14	0.00
MW94121	11/23/94	CARROT CONC. BEFORE PASTURIZA	0.00	16.04	2.75	2.75	21.54	0.00
MW94122	11/30/94	ORGANIC CARROT JUICE CONC	0.00	18.75	0.59	1.18	20.52	0.00
MW94123	12/15/94	GRANNY SMITH/FUJI	1.95	4.00	17.92	34.27	58.13	0.03
MW94124	12/15/94	GRANNY SMITH/MIX	1.63	5.52	17.33	32.15	56.63	0.03
MW94125	12/15/94	APPLE CONCENTRATE	1.89	3.80	17.27	32.52	55.47	0.03
MW94126	12/15/94	APPLE CONCENTRATE	1.79	6.48	16.32	32.40	56.99	0.03
MW94127	12/15/94	GRANNY SMITH/MIX	1.67	1.53	17.73	32.03	52.96	0.03
MW94128	12/19/94	LOW ACID APPLE JUICE CONCENTRA	2.45	6.57	17.56	35.41	62.01	0.04
MW94129	12/19/94	100% GRANNY SMITH	1.90	6.28	18.45	31.66	58.30	0.03

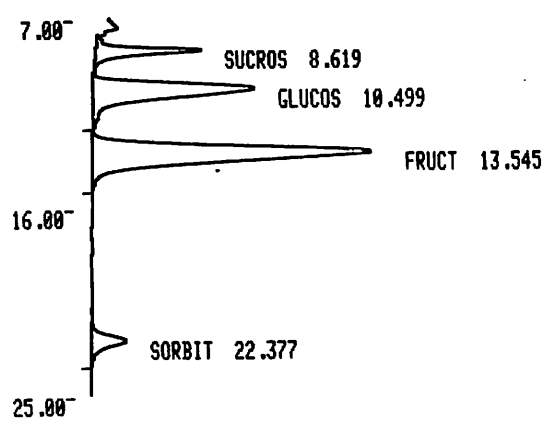
1	SUCROS	8.628	0.100000	.245187e-06
2	GLUCOS	10.506	1.000000	.268347e-06
3	FRUCT	13.557	1.250000	.181095e-06
4	SORBIT	22.406	0.100000	



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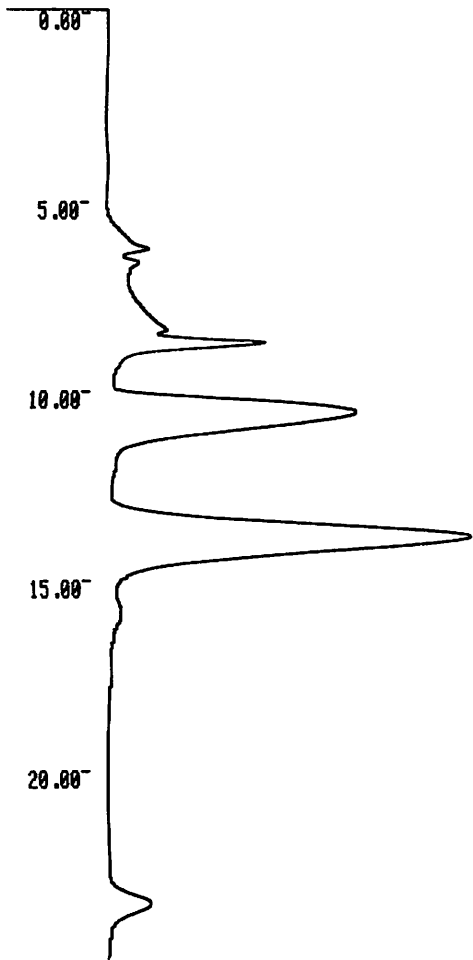
CAL. METHOD 04
 SF PA PB
 .100000e+01 .100000e+01 .100000e+01

NO.	NAME	RT	A OR H	MK	CONC
1	SUCROS	8.619	554827		0.1231
2	GLUCOS	10.499	1801913	M	0.4418
3	FRUCT	13.545	3307984	M	0.8876
4	SORBIT	22.377	326183	M	0.0590
TOTAL			5990908		1.5117

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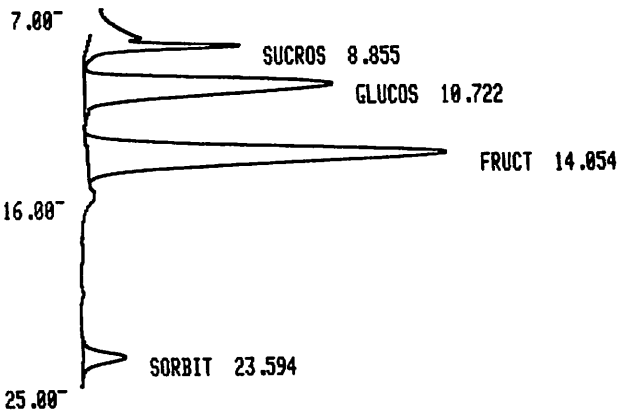
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SAMPLE 18

16:03 FEB. 13 1995



CAL. METHOD 04
 SF PA PB
 .100000₁₀+01 .100000₁₀+01 .100000₁₀+01

NO.	NAME	RT	A OR H	MK	CONC
1	SUCROS	8.855	673361		0.1818
2	GLUCOS	10.722	3094274		0.7956
3	FRUCT	14.054	4620348		1.2123
4	SORBIT	23.594	364591		0.1038
	TOTAL		8752576		2.2936

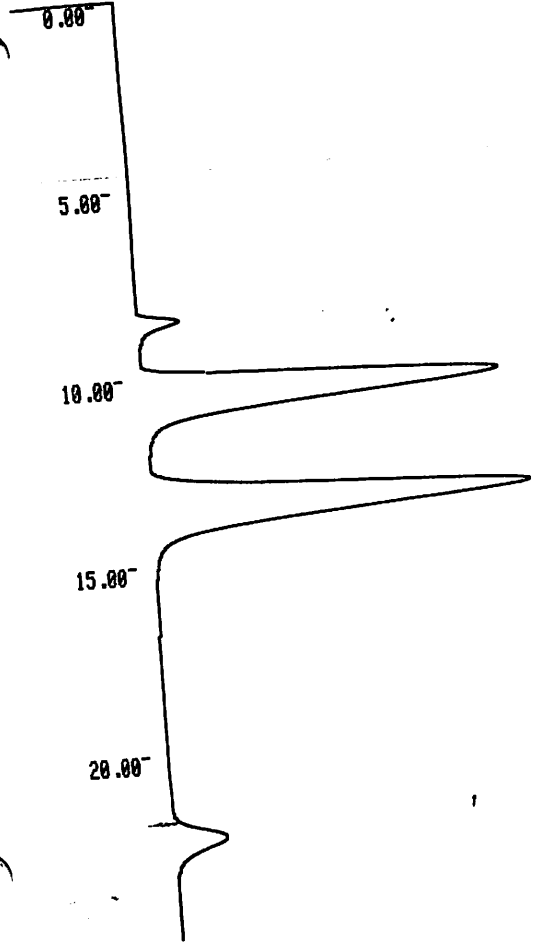
039

#105

1	SUCROS	8.629
2	GLUCOS	10.509
3	FRUCT	13.549
4	SORBIT	22.404

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0.10000	

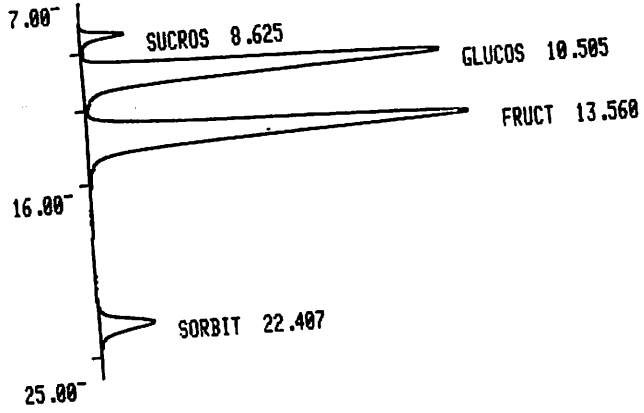
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SAMPLE 28

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057



CAL. METHOD 04
 SF .100000E+01 PA .100000E+01 PB .100000E+01

NO.	NAME	RT	A OR H	MK	CONC
1	SUCROS	8.625	225220	M	0.0495
2	GLUCOS	10.505	4078514	M	0.9983
3	FRUCT	13.560	4658134	M	1.2491
4	SORBIT	22.407	552193	M	0.0991
TOTAL			9514062		2.3961