

INTRODUCTION AND GENERAL METHODS

Oranges, grapefruit, mandarins, and lemons are among the top 20 fruits for which retailers must post FDA-published nutrition information at the point of sale.

The goal of the present research was to conduct a pilot study, in which California oranges, grapefruit, mandarins, and lemons would be collected mid-season and analyzed for nutrient content. The study results are intended to form the basis for future sampling and testing protocols, to help substantiate health and nutrient claims, and to provide current data for nutrition labeling and regulatory purposes.

Samples were collected from packing houses in California and shipped to Covance Laboratories in Madison, Wisconsin for chemical analysis. Each sampler shipped fruit from one harvest date and growing region, documenting information about the fruit and its chain of custody. The laboratory carefully removed the rind, seeds, and core and analyzed the edible portion for nutrient content. Each sample lot for analysis was comprised of twelve fruit from a single packing house.

Oranges. Two varieties were analyzed in this study. Washington Navel oranges were harvested in February 1998 from Tulare County, CA. Valencias were harvested in August 1998 from Ventura County, CA. Each variety was composited and analyzed separately by the laboratory.

Nationally, navel oranges represent approximately 65% of the fresh use of oranges, with Valencia oranges representing approximately 35% (statistics for crops 1998-99 through 2000-01 in: "Citrus Fruits 2001 Summary," September 2001, Agricultural Statistics Board, NASS, USDA).

Grapefruit. Rio Red grapefruit were harvested in March 1998 from Riverside County, CA.

Mandarins. Delight mandarin oranges were harvested in February 1998 from Tulare County, CA.

Lemons: Lemon samples were harvested in July 1998 from Ventura County, CA.

Results of the laboratory analyses are summarized in the tables on the following pages. Calories and calories from fat have been calculated using the specific energy factors (Atwater factors) appropriate for each fruit type. The energy factors are presented in each table under the column heading "E Factor."

The summary tables are followed by Covance Laboratory reports of the analytical data and methods.

WASHINGTON NAVEL ORANGES AND VALENCIA ORANGES, PER 100G AND PER 154G

Lab No.: 80300406, 80803202

Lab Date: 3/3/98, 8/18/98

Harvest Date: 2/21/98, 8/5/98

Region: Tulare County, Ventura County

Nutrient	Unit	E Fact	Navel/ 100g	Valencia/ 100g	Mean/ 100g	Mean/Svg 1.54	%DV/ Svg	Lbl Value	Lbl %DV
Water	g		85.100	87.900	86.500	133.210			
Ash	g		0.400	0.400	0.400	0.616			
Calories	kcal		52.452	42.338	47.395	72.988		70	
Cal fr Fat	kcal		0.778	0.762	0.770	1.186		0	
Total Fat (GC)	g	8.37	0.093	0.091	0.092	0.142	0.22%	0	0%
Sat Fat	g		0.025	0.021	0.023	0.035	0.18%	0	0%
Poly Fat	g		0.064	0.035	0.050	0.076		0	
Mono Fat	g		0.004	0.035	0.020	0.030		0	
Sodium	mg		0.480	0.880	0.680	1.047	0.04%	0	0%
Potassium	mg		164.000	156.000	160.000	246.400	7.04%	250	7%
Carbo	g	3.60	13.607	10.709	12.158	18.723	6.24%	19	6%
D Fiber Prosky	g		2.000	1.600	1.800	2.772	11.09%	3	12%
D Fiber Lee	g		1.800	1.700	1.750	2.695	10.78%		
Soluble Fiber	g		<1.000	<1.000	<1.000	<1.540			
Insoluble Fiber	g		1.800	1.700	1.750	2.695			
Sugars	g		9.000	8.400	8.700	13.398		13	
Protein	g	3.36	0.800	0.900	0.850	1.309		1	
Vit A	IU		66.700	180.000	123.350	189.959	3.80%		4%
Vit C	mg		64.100	51.500	57.800	89.012	148.35%		150%
Calcium	mg		36.500	33.000	34.750	53.515	5.35%		6%
Iron	mg		0.128	0.145	0.137	0.210	1.17%		2%
Vit E	IU		0.481	0.523	0.502	0.773	2.58%		2%
Thiamin	mg		0.070	0.100	0.085	0.131	8.73%		8%
Riboflavin	mg		0.040	0.030	0.035	0.054	3.17%		4%
Niacin	mg		0.380	0.300	0.340	0.524	2.62%		2%
Vitamin B6	mg		0.066	0.070	0.068	0.105	5.24%		6%
Folate	mcg		35.100	49.400	42.250	65.065	16.27%		15%
Panto Acid	mg		0.180	0.250	0.215	0.331	3.31%		4%
Phosphorus	mg		21.100	20.900	21.000	32.340	3.23%		4%
Magnesium	mg		10.300	11.300	10.800	16.632	4.16%		4%
Zinc	mg		0.142	0.057	0.100	0.153	1.02%		2%
Selenium	mcg		< 0.500	< 0.500	< 0.500	< 0.770	<1.10%		
Copper	mg		0.052	0.036	0.044	0.068	3.39%		4%
Manganese	mg		0.022	0.020	0.021	0.032	1.62%		2%
Chromium	mcg		<5.000	<5.000	<5.000	<7.700	<6.42%		
Molybdenum	mcg		<2.000	<2.000	<2.000	<3.080	<4.11%		
Boron	mg		0.200	0.322	0.261	0.402			

RIO RED GRAPEFRUIT, PER 100G AND PER 154G SERVING

Lab No.: 80302099 Lab Date: 3/11/98
 Harvest Date: 3/6/98 Region: Riverside County

Nutrient	Unit	E Fact	Units/ 100g	Units/Svg 1.54	%DV/ Svg	Lbl Value	Lbl %DV
Water	g		88.100	135.674			
Ash	g		0.500	0.770			
Calories	kcal		41.092	63.281		60	
Cal fr Fat	kcal		0.343	0.528		0	
Total Fat (GC)	g	8.37	0.041	0.063	0.10%	0	0%
Sat Fat	g		0.009	0.014	0.07%	0	0%
Poly Fat	g		0.019	0.029		0	
Mono Fat	g		0.013	0.020		0	
Sodium	mg		2.800	4.312	0.18%	0	0%
Potassium	mg		154.000	237.160	6.78%	240	7%
Carbo	g	3.60	10.759	16.569	5.52%	17	6%
D Fiber Prosky	g		1.100	1.694	6.78%	2	8%
D Fiber Lee	g		1.500	2.310	9.24%		
Soluble Fiber	g		<1.000	<1.540			
Insoluble Fiber	g		1.500	2.310			
Sugars	g		5.300	8.162		8	
Protein	g	3.36	0.600	0.924		1	
Vit A	IU		650.000	1001.000	20.02%		20%
Vit C	mg		30.300	46.662	77.77%		80%
Calcium	mg		23.800	36.652	3.67%		4%
Iron	mg		0.114	0.176	0.98%		0%
Vit E	IU		0.378	0.582	1.94%		2%
Thiamin	mg		0.010	0.015	1.03%		2%
Riboflavin	mg		0.020	0.031	1.81%		2%
Niacin	mg		0.230	0.354	1.77%		2%
Vitamin B6	mg		0.044	0.068	3.39%		4%
Folate	mcg		11.700	18.018	4.50%		4%
Panto Acid	mg		0.230	0.354	3.54%		4%
Phosphorus	mg		16.400	25.256	2.53%		2%
Magnesium	mg		8.690	13.383	3.35%		4%
Zinc	mg		0.164	0.253	1.68%		2%
Selenium	mcg		< 0.500	< 0.770	<1.10%		
Copper	mg		0.034	0.052	2.62%		2%
Manganese	mg		0.023	0.035	1.77%		2%
Chromium	mcg		<5.000	<7.700	<6.42%		
Molybdenum	mcg		<2.000	<3.080	<4.11%		
Boron	mg		0.162	0.249			

DELIGHT MANDARIN ORANGES, PER 100G AND PER 109G SERVING

Lab No.: 80300412 Lab Date: 3/3/98
 Harvest Date: 2/27/98 Region: Tulare County

Nutrient	Unit	E Fact	Units/ 100g	Units/Svg 1.09	%DV/ Svg	Lbl Value	Lbl %DV
Water	g		86.900	94.721			
Ash	g		0.400	0.436			
Calories	kcal		45.814	49.937		50	
Cal fr Fat	kcal		0.670	0.730		0	
Total Fat (GC)	g	8.37	0.080	0.087	0.13%	0	0%
Sat Fat	g		0.016	0.017	0.09%	0	0%
Poly Fat	g		0.039	0.043		0	
Mono Fat	g		0.025	0.027		0	
Sodium	mg		0.850	0.927	0.04%	0	0%
Potassium	mg		160.000	174.400	4.98%	170	5%
Carbo	g	3.60	11.420	12.448	4.15%	12	4%
D Fiber Prosky	g		1.400	1.526	6.10%	2	8%
Soluble Fiber	g		<1.000	<1.090			
Insoluble Fiber	g		<1.000	<1.090			
Sugars	g		7.800	8.502		9	
Protein	g	3.36	1.200	1.308		1	
Vit A	IU		783.000	853.470	17.07%		15%
Vit C	mg		28.900	31.501	52.50%		50%
Calcium	mg		31.300	34.117	3.41%		4%
Iron	mg		0.149	0.162	0.90%		0%
Vit E	IU		0.861	0.938	3.13%		4%
Thiamin	mg		0.070	0.076	5.09%		6%
Riboflavin	mg		0.030	0.033	1.92%		2%
Niacin	mg		0.170	0.185	0.93%		
Vitamin B6	mg		0.112	0.122	6.10%		6%
Folate	mcg		21.700	23.653	5.91%		6%
Panto Acid	mg		0.420	0.458	4.58%		4%
Phosphorus	mg		20.600	22.454	2.25%		2%
Magnesium	mg		10.600	11.554	2.89%		2%
Zinc	mg		0.121	0.132	0.88%		
Selenium	mcg		<0.500	<0.545	<0.78%		
Copper	mg		0.062	0.068	3.38%		4%
Manganese	mg		0.053	0.058	2.89%		2%
Chromium	mcg		<5.000	<5.450	<4.54%		
Molybdenum	mcg		<2.000	<2.180	<2.91%		
Boron	mg		0.112	0.122			

LEMONS, PER 100G AND PER 58G SERVING

Lab No.: 80901233 Lab Date: 9/22/98
 Harvest Date: 7/23/98 Region: Ventura County

Nutrient	Unit	E Fact	Units/100g	Units/Svg 0.58	%DV/Svg	Lbl Value	Lbl %DV
Water	g		89.300	51.794			
Ash	g		0.400	0.232			
Calories	kcal		26.237	15.217		15	
Cal fr Fat	kcal		0.109	0.063		0	
Total Fat (GC)	g	8.37	0.013	0.008	0.01%	0	0%
Sat Fat	g		0.003	0.002	0.01%	0	0%
Poly Fat	g		0.006	0.003		0	
Mono Fat	g		0.004	0.002		0	
Sodium	mg		1.630	0.945	0.04%	0	0%
Potassium	mg		151.000	87.580	2.50%	90	3%
Carbo	g	2.48	9.587	5.560	1.85%	6	2%
D Fiber Prosky	g		2.300	1.334	5.34%	1	4%
D Fiber Lee	g		3.200	1.856	7.42%		
Soluble Fiber	g		1.400	0.812			
Insoluble Fiber	g		1.900	1.102			
Sugars	g		3.300	1.914		2	
Protein	g	3.36	0.700	0.406		0	
Vit A	IU						0%
Vit C	mg		41.600	24.128	40.21%		40%
Calcium	mg		24.900	14.442	1.44%		2%
Iron	mg		0.141	0.082	0.45%		0%
Thiamin	mg		0.030	0.017	1.16%		2%
Riboflavin	mg		0.020	0.012	0.68%		
Niacin	mg		0.170	0.099	0.49%		
Vitamin B6	mg		0.050	0.029	1.45%		2%
Folate	mcg		26.200	15.196	3.80%		4%
Panto Acid	mg		0.210	0.122	1.22%		2%
Phosphorus	mg		21.400	12.412	1.24%		2%
Magnesium	mg		8.070	4.681	1.17%		2%
Zinc	mg		0.282	0.164	1.09%		2%
Selenium	mcg		<0.500	<0.290	<0.41%		
Copper	mg		0.053	0.031	1.54%		2%
Manganese	mg		0.021	0.012	0.61%		
Chromium	mcg		<5.000	<2.900	<2.42%		
Molybdenum	mcg		<2.000	<1.160	<1.55%		
Boron	mg		0.150	0.087			