CHEMICAL COMPOSITION OF GRAPE JUICES: A VARIETAL STUDY

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The departments of Horticulture and Agricultural Chemistry Research, during the years 1928-38, investigated many phases of the growth, culture, and composition of grapes in Oklahoma, using vineyards at Henryetta and Stillwater, Oklahoma. Reports of these studies have been published in various journals (Webster and Cross 1936a, 1936b, and 1937) but none of them have included a comprehensive summary of the chemical composition of grape juices prepared from Oklahoma-grown varieties.

This paper reports analyses of all of the varieties studied at both locations. As might be expected when a large number of varieties are studied, certain varieties, for one reason or another, failed to yield satisfactory samples in a given year and thus the analyses cover varying lengths of time. The samples from Henryetta cover a range of from one to four years; those from Stillwater are for one year only.

The samples from Henryetta were secured from a vineyard located one mile north of the city on a sandy-loam type of soil of the Parsons series. The soil is moderately fertile and sloping, and has only fair drainage, with serious sheet washing at times. Some winter injury to the plants occurred following the exposure of the surface root system, which tended to make yields erratic toward the close of the experiment. The Stillwater vineyard was located at the Perkins experimental farm, some ten miles from the College. The soil is similar to a Stidham fine sand.

PREPARATION OF JUICE AND CHEMICAL METHODS

Preparation of juice. Since Henryetta and Stillwater are approximately 100 miles apart, samples from Henryetta were picked one day and shipped to Stillwater, where the juice was prepared the following morning. The samples of grapes from Stillwater, although relatively close at hand, were also allowed to stand over night before pressing.

Approximately 15 pounds of sorted grapes constituted a sample used in preparing the juice. The berries were removed from the clusters, placed in a kettle, crushed, and heated to 180° F to aid in expressing the juice The heated samples were then pressed in a lard press and the juice filtered through muslin cloth. The juice from each variety was then placed in a quart can, sealed, and pasteurized at 185° F for 5 minutes. The samples were then stored for 2 to 5 months, after which the clear juice was drawn off for analysis. The juice samples from Stillwater were stored in glass bottles rather than in tin cans.

Methods. *Reducing sugars* were determined on clarified juice samples (using neutral lead acetate and deleading with potassium oxalate) by the Shaffer-and-Hartmann (1921) procedure. *Sucrose* was determined by the same procedure after inversion by invertase. *Acidity percentages*, calculated as tartaric acid, were secured by titration, using phenolphthalein as an indicator. *Astringency values* were secured by using the Loewenthal-Proctor method (Griffin 1936) for tannins. *Density* was measured by the use of a Westphal balance.

TABLE I

Chemical composition of grape juice, Henryetta, 1931-1934

Variety	Sugars (per cent)		Acidity (per cent)	Astringency (gms per liter)			Density (15.6 degrees C)	Acid: sugar ratio
	Red.	Total		Total	Tannins	Non tannins		
Agawam (3) [a]	13.25	13.64	.715	2.423	1.290	1.133	1.076	1:19.1
Albania (2)	14.50	15.17	.889	1.786	.507	1.279	1.079	1:17.1
America (4)	11.58	11.85	.982	4.648	2.119	2.529	1.070	1:12.7
Armalaga (2)	14.56	14.70	.442	1.257	.287	.970	1.079	1:33.3
Bachman Early (3)	13.41	13.51	.721	1.904	1.025	.879	1.072	1:18.7
Bailey (4)	14.30	14.47	.806	1.766	.691	1.075	1.077	1:18.0
Beacon (3)	12.40	12.72	.915	1.598	.497	1.101	1.073	1:13.9
Bell (2)	12.13	12.47	.729	1.029	.210	.819	1.072	1:17.1
Brighton (3)	13.53	13.93	.566	1.982	1.021	.961	1.080	1:24.6
Caco (1)	9.19	9.19	.568	1.688	.331	1.357	1.062	1:16.2
Campbell Early (3)	10.83	10.91	.641	1.702	.686	1.016	1.058	1:17.0
Captivator (3)	10.98	11.10	.613	1.744	.724	1.020	1.063	1:18.1
Carman (3)	12.92	13.15	.412	1.581	.508	1.073	1.072	1:31.9
Catawba (4)	13.60	13.87	.652	1.684	.721	.963	1.075	1:21.3
Cloeta (4)	10.59	10.72	.623	2.124	.890	1.234	1.062	1:17.2
Concord (4)	11.83	11.95	.724	2.075	1.034	1.041	1.064	1:16.5
Delaware (2)	12.94	12.94	.830	1.979	.937	1.042	1.074	1:15.6
Diamond (3)	11.85	12.07	.773	1.273	.322	.951	1.063	1:15.6
Edna (3)	16.33	16.33	.494	1.871	.703	1.168	1.088	1:33.1
Ellen Scott (4)	14.97	15.03	.591	1.117	.417	.751	1.080	1:25.4
Extra (4)	14.83	15.02	.654	1.404	.434	.970	1.081	1:23.0
Fern Munson (4)	14.14	14.17	.655	1.361	.455	.906	1.074	1:21.6
Goethe (1)	14.88	14.88	.631	1.453	.559	.894	1.081	1:23.6
Headlight (1)	13.57	13.57	.539	1.143	.208	.935	1.070	1:25.2
Herbemont (2)	16.26	16.26	.694	.958	.165	.793	1.085	1:23.4
Jaeger, H. (2)	17.14	18.30	.696	1.646	.569	1.077	1.100	1:26.3
Ladano (2)	15.51	15.93	.960	1.196	.371	.825	1.085	1:16.6
Last Rose (2)	12.77	12.77	.754	2.228	1.126	1.102	1.074	1:16.9
Lenoir (4)	14.80	15.09	.910	2.193	.943	1.250	1.086	1:16.6
Lomanto (3)	10.87	11.04	.994	1.927	.791	1.136	1.061	1:11.2
Lucile (3)	11.87	11.92	.810	1.746	.379	1.367	1.066	1:14.7
Lutie (2)	9.63	9.77	.708	1.206	.272	.918	1.040	1:13.8
Manito (2)	12.38	12.38	1.018	2.381	1.206	1.175	1.070	1:12.2
Moore Early (4)	10.70	10.72	.726	2.270	1.132	1.138	1.057	1:14.8
Muench (4)	14.47	14.62	.522	1.542	.646	.896	1.078	1:28.0
Munson Hybrid (1)	15.12	15.12	.510	.765	.765	.000	1.075	1:29.6
Niagara (3)	11.27	11.32	.639	1.520	.680	.840	1.059	1:17.7
Norton (3)	14.54	14.69	.915	3.454	1.749	1.705	1.090	1:16.1
President (4)	11.41	11.61	.610	2.918	1.535	1.383	1.062	1:19.0
R. W. Munson (3)	13.12	13.45	.652	2.276	1.211	1.065	1.073	1:20.6
Salamander (1)	12.89	13.96	.583	.974	.172	.802	1.073	1:23.9
Winchell (1)	10.91	11.17	.718	1.522	.608	.914	1.067	1:15.6
Worden (4)	11.81	12.00	.681	2.257	1.101	1.156	1.065	1:17.6
Xlnta (4)	12.06	12.12	.886	2.284	1.025	1.259	1.070	1:13.7

[a] The figure in parenthesis following the name gives the number of years for which analyses are presented.

TABLE II

Chemical analysis of grape juice, Stillwater, 1935.

Average composition of juice from grapes grown on the top and bottom wires of the Kniffen system

Variety	Sugars (per cent)		Acidity (per cent)	Astringency (gms per liter)			Density (15.6 degrees C)	Acid: sugar ratio
	Red.	Total		Total	Non tannins	Tannins		
America	11.73	12.35	.696	1.599	1.140	.459	1.0690	1:18.3
Armalaga	11.32	11.65	.483	.639	.639	.000	1.0677	1:24.6
Bailey	12.34	12.56	.747	1.263	.954	.309	1.0678	1:16.9
Beacon	13.48	12.61	1.149	.912	.654	.263	1.0763	1:11.9
Caco	7.74	8.33	.563	1.190	.863	.278	1.0617	1:14.7
Captivator	8.05	8.29	.587	1.065	.862	.327	1.0559	1:14.2
Carman	14.29	14.63	.590	1.299	.991	.309	1.0768	1:24.9
Catawba	12.09	12.30	.637	1.369	.948	.422	1.0718	1:19.4
Cloeta	11.55	12.13	.784	2.084	1.287	.798	1.0702	1:15.9
Delaware	16.22	16.25	.714	1.708	.943	.765	1.0924	1:22.8
Diamond	16.71	17.27	.601	1.238	.742	.496	1.0905	1:28.9
Extra	12.64	12.88	.653	.852	.682	.170	1.0680	1:24.8
F. Munson	12.65	13.13	.728	.926	.598	.329	1.0762	1:18.1
Goethe	12.16	12.23	.412	.771	.565	.207	1.0645	1:29.8
Golden Muscat	13.24	13.94	.735	1.208	.896	.312	1.0800	1:19.0
Herbemont	13.88	14.17	.752	.544	.470	.735	1.0774	1:18.9
Martha	12.34	12.47	.386	1.299	1.045	.255	1.0680	1:32.7
Mathilda	11.65	11.82	.490	.597	.597	.000	1.0661	1:24.3
Maricadel	11.79	11.96	.693	1.853	1.278	.576	1.0670	1:17.6
Minnie	11.46	11.87	.517	.937	.896	.041	1.0680	1:23.0
Muench	11.52	12.58	.556	1.566	.725	.842	1.0710	1:22.7
Niagara	11.27	11.53	.657	1.119	.782	.337	1.0660	1:17.6
Pocklington	9.99	11.57	.496	1.112	.779	.335	1.0635	1:23.3
Rommel	13.00	11.99	.660	.683	.595	.089	1.0680	1:18.2
Ronalda	10.20	13.02	.779	.811	.788	.023	1.0671	1:16.7
Urbana	11.58	11.71	.283	.742	.533	.229	1.0604	1:42.2
Wine King	9.69	9.81	.717	1.482	1.787	.746	1.0656	1:13.9

DISCUSSION

The data given in Table I represent a condensation of analyses for several years, the number of years being indicated by the figures in parentheses following the names. In Table II the figures represent the averages of two sets of analyses, one on a juice sample prepared from grapes grown on the bottom wire of a Kniffen-type trellis and the other on a sample from the top wire of the same system.

This condensation of data, necessary for economy of printing, should be considered in studying the tables. Too much reliance should not be placed on one-year's data, particularly for sugar percentage where the overall fluctation in a variety (4-years' data) may be as much as 50 per cent.

Results are similar to those given by Reynolds and Vaile (1942) and mentioned in an earlier paper (Webster and Cross 1936) showing a considerably lower percentage of sugar in many of the juices than was reported by Shoemaker (1935) and Caldwell (1925) for samples from northern and eastern sections of the United States. From an examination of the detailed figures (not published) it is apparent that the juice from nearly every variety during some season contains a small percentage of sucrose but that during a majority of the years sucrose is absent from most varieties.

The lower sugar content of Oklahoma grapes is partially compensated for by the lower acidity percentages, so that the acid:sugar ratio remains generally favorable.

The qualities of the various varieties other than the composition of the juice are given by Cross and Locke (1939) and Cross and Webster (1942). The importance of the various chemical components in relation to either eating or juice-making is discussed by Reynolds and Vaile (1942) and Shoemaker (1935).

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