No.	Solution.	Standard acid taken for the test. cc.	Standard sodium hydroxide required. cc.	Equivalent volume of 0.10 N NaOH. cc.
2	0.1 N HCl	10.0	10.2	10.01
		10.0	10.2	10.01
		20.0	20.4	20.02
3	0.2 N HCl	10.0	20.4	20.02
		10.0	20.35	19.97
		20.0	40.75	40.00
4	0.1 N HNO_3	10.0	10.2	10.01
		10.0	10.2	10.01
		20.0	20.4	20.02
5	0.2 N HNO_3	10.0	20.4	20.02
		10.0	20.4	20.02
		20.0	40.7	39.94
		20.0	40.75	40.00

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THE COMPOSITION OF JELLIES AND JAMS.

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AS preliminary to the examination of a large number of samples of commercial fruit preserves, it was thought desirable to have, as a basis of comparison, the analyses of fruits and fruit products of known origin, as the work with this class of foods has been largely confined to the detection of adulterations rather than to the proximate analysis. Accordingly, such whole fruits as were to be obtained were purchased, and from these the juices, jellies, and jams were prepared. The juices were prepared by cooking the cleaned fruit, with enough water to prevent scorching, till it became soft, and straining through a jelly-bag. In the preparation of the jellies, equal parts of the strained juice and cane-sugar were used and were heated to the point of boiling, which required about twenty minutes.

With the jams approximately one part of sugar was used to two parts of the crushed fruit, heated to boiling, and this temperature maintained for about twenty minutes. In all cases the original fruit and sugar, as well as the final products, were weighed which gave a basis for estimating the amount of added cane-sugar in the finished product.

It is to be regretted that the fruits selected were not in all cases of typical composition. This is especially true of the apples and grapes. This, however, will not lessen their value for studying the sugar content. In comparing the composition of jellies and jams with that of the juices and pulps from which they were prepared, allowance must be made for the changes in composition resulting from the evaporation of water and the loss of proteid and other matter in the scum that rises in the process of preparation.

METHODS OF ANALYSIS.

With the juices and thoroughly pulped fruits and jams, weighed amounts were taken for each determination. With the jellies, it was found more convenient to dissolve 50 grams of the material in water and make it up in volume to 500 cc. Then aliquot portions were taken for solids, ash, acids, nitrogen, and reducing sugars.

Total solids were determined in about 10 grams of the juice and the crushed fruits, and about 5 grams of the jellies and jams, by drying in large flat-bottomed platinum dishes at a temperature of 100° for ten to twelve hours. The writers recognize that drying in vacuo at a low temperature is preferable, but since that would be impracticable with the large volume of work planned with commercial products, it was not done with these samples. Water in sufficient quantity to make them flow readily was mixed with the portion of the jams and crushed fruit taken for the determination of total solids, so that they could be distributed in an even layer over the bottom of the dish.

To estimate the ash the residue obtained in the determination of total solids was thoroughly charred, exhausted with water, the insoluble portion washed with water and collected on a filter. The filter-paper and contents were then returned to the dish and ignited to whiteness, the soluble ash, and a few drops of ammonium carbonate solution added, and the whole evaporated to dryness, heated to low redness, and weighed.

In the estimation of acidity about 10 grams were dissolved in hot water and diluted to about 400 cc. with recently boiled water. A few drops of phenolphthalein solution were then added and the mixture titrated with a decinormal solution of potassium hydroxide. The end point was easily observed even in highly colored fruits. Owing to the dissimilarity of the various fruits in their characteristic acids, it is found advantageous to express acidity in terms of one acid instead of the acid characteristic of the particular fruit which is supposed to be present. The use of an acid, which occurs in some fruits and not in others, is likely to lead to confusion. The writers prefer the custom which is practiced in many laboratories of expressing results in terms of sulphuric acid (H_2SO_4).

Nitrogen was determined by the Gunning method in such an amount of material as would give about 2 grams of dry matter and the result multiplied by 6.25 for the proteid content.

Reducing sugars were determined by the regular Allihn method.[1]

Cane-sugar was calculated from the direct and invert polarizations by the Clerget formula

$$S = \frac{A - B}{144 - \frac{2}{t}}.$$

Polarizations were made upon normal weights of the juices and fruits and upon half-normal weights of the jellies and jams, with the Schmidt and Haensch instrument, using a 200 mm. tube. All results were calculated to normal weights.

As is well known the sugars of the fruits are largely reducing sugars, but in all the fruits examined, except the blackberry, cane-sugar was found in varying amounts. In the orange, peach, and pineapple it was in excess of the reducing sugar.

The polarization of the Damson plum is peculiar in that the invert reading at 86° is positive, indicating an excess of dextrose over levulose, while all the other fruits have either a zero or a negative reading at this temperature.

The inversion in the preparation of jams and jellies of the added cane-sugar is of particular interest. As might be expected the extent of inversion varies in general with the amount of free organic acid present, and with the length of the time the product is heated. Still the different fruit acids vary widely in their inverting action upon cane-sugar and consequently there are some marked exceptions to the general rule mentioned above. For example, in crab apple jelly, with 0.17 per cent. acid, 58.8 per cent. of the cane-sugar was inverted, while with the orange jelly of the same acid content only 4.9 per cent. was inverted. With the fox grape jam containing 0.69 per cent. acid, 92.9 per cent. of cane-sugar was inverted, while with wild fox plum containing 1.35 per cent. acid only 53.4 was inverted. The crab apple excepted, the jams and marmalades showed a higher per cent. of inversion than the corresponding jellies, owing to the fact that they were heated for a much longer time.

[1] Bulletin 46: Rev. U. S. Department of Agriculture, Division of Chemistry.

TABLE I.—JUICE.[1]

Laboratory No.	Description of sample.	Total solids. Per cent.	Ash. Per cent.	Total acids calculated as H_2SO_4. Per cent.	Proteids (N × 6.25). Per cent.	Sugars. Reducing sugar. Per cent.	Sugars. Cane-sugar added. Per cent.	Sugars. Cane-sugar found. Per cent.	Sugars. Added cane-sugar inverted. Per cent.	Polarization. Direct at at 18° C.	Polarization. Invert at 18° C.	Polarization. Invert at 80° C.
20400	Apple (fall pippin)	7.95	0.47	0.627	0.543	4.00	....	1.18	....	−3.0	−4.6	−2.9
20396	Blackberry	8.54	0.52	0.978	0.350	4.34	....	0.00	....	−1.5	−1.6	−1.0
20403	Crab apple	5.62	0.20	0.372	0.075	2.56	....	1.03	....	−1.0	−2.4	−1.1
20428	Grape (fox)	6.67	0.49	1.686	....	2.79	....	0.37	....	−0.8	−1.3	−1.1
20401	Grape (Ives seedling)	8.83	0.57	0.902	0.237	5.10	....	0.89	....	−1.2	−2.4	−0.6
20397	Huckleberry	16.33	0.40	0.454	....	11.21	....	0.89	....	−3.2	−4.4	−0.9
20430	Orange (Florida navel)	6.08	0.36	0.297	0.581	1.52	....	2.29	....	+1.8	−1.3	0.0
20427	Peach	8.90	0.45	....	0.218	....	....	4.59	....	+4.0	−2.2	−0.7
20431	Pear (Bartlett)	11.65	0.45	0.345	0.087	5.87	....	1.18	....	−4.8	−6.4	−4.0
20429	Pineapple	13.27	0.45	0.588	0.368	2.74	....	8.96	....	+8.4	−3.7	−1.1
20426	Pineapple husk juice	8.43	0.77	....	0.350	....	....	4.73	....	+4.1	−2.3	−0.7
20399	Plum (Damson)	12.72	0.63	....	0.431	4.86	....	0.51	....	+2.0	+1.3	+2.4
20402	Plum (wild fox)	11.23	0.64	1.576	0.137	2.87	....	2.81	....	+1.4	−2.4	−1.8
20398	Mixed fruit	6.53	0.32	0.612	0.150	2.68	....	0.59	....	−1.0	−1.8	−0.9

[1] The "juice" was prepared by cooking the fruit till soft, after the addition of sufficient water to prevent scorching, and straining through a jelly bag.

TABLE II.—JELLY.

Laboratory No.	Description of sample.	Total solids. Per cent.	Ash. Per cent.	Total acids calculated as H_2SO_4. Per cent.	Proteids (N × 6.25). Per cent.	Sugars. Reducing sugars. Per cent.	Sugars. Cane-sugar added. Per cent.	Sugars. Cane-sugar found. Per cent.	Sugars. Added cane-sugar inverted. Per cent.	Polarization. Direct at 18° C.	Polarization. Invert at 18° C.	Polarization. Invert at 86° C.
20408	Apple (fall pippin)	59.18	0.22	0.279	0.175	20.78	51.76	33.04	36.17	+ 24.0	— 20.6	— 1.2
20405	Blackberry	59.63	0.33	0.475	0.243	12.51	54.89	44.90	18.20	+ 47.0	— 20.1	0.0
20410	Crab apple	63.28	0.11	0.171	0.137	34.93	57.61	23.68	58.88	+ 13.0	— 19.0	0.0
20405	Grape (Ives seedling)	63.66	0.45	0.524	0.175	32.29	60.29	30.52	49.33	+ 22.3	— 18.9	+ 0.2
20412	Huckleberry	63.02	0.28	0.245	0.069	24.27	53.39	32.74	37.54	+ 24.1	— 20.1	— 0.4
20435	Orange (Florida navel)	68.56	0.30	0.171	0.418	3.95	65.59	62.52	4.91	+ 61.3	— 23.1	— 0.2
20437	Peach	69.98	0.21	0.245	0.175	8.75	63.70	56.59	11.16	+ 53.4	— 23.0	— 0.6
20434	Pear (Bartlett)	69.12	0.34	0.181	0.156	6.58	63.09	58.46	7.33	+ 52.7	— 26.2	— 1.8
20436	Pineapple	80.28	0.43	0.328	0.387	22.13	72.98	56.70	28.45	+ 50.4	— 26.1	0.0
20433	Pineapple husk	76.34	0.73	0.352	0.350	7.40	70.22	65.22	7.12	+ 63.7	— 24.3	— 0.6
20404	Plum (Damson)	45.56	0.68	1.127	0.350	19.18	38.00	22.67	40.38	+ 17.8	— 12.8	0.0
20409	Plum (wild fox)	54.49	0.40	1.029	0.138	24.00	48.05	25.48	46.97	+ 16.7	— 17.8	0.0
20411	Plum (wild fox) boiled down	73.01	0.65	1.529	0.175	44.22	64.66	22.37	66.18	+ 7.6	— 22.6	— 0.6
20407	Mixed fruit	66.58	0.21	0.367	0.069	39.70	59.72	24.22	40.38	+ 14.8	— 17.9	+ 2.2

TABLE III.—FRUIT.[1]

Laboratory No.	Description of sample.	Total solids. Per cent.	Ash. Per cent.	Total acids calculated as H_2SO_4. Per cent.	Proteids (N × 6.25). Per cent.	Sugars. Reducing sugars. Per cent.	Sugars. Cane-sugar added. Per cent.	Sugars. Cane-sugar found. Per cent.	Sugars. Added cane-sugar inverted. Per cent.	Polarizations. Direct at 18° C.	Polarizations. Invert at 18° C.	Polarizations. Invert at 86° C.
20449	Apple (fall pippin).....	8.25	0.30	0.499	....	4.13	....	1.03	....	−2.2	−3.6	−1.8
20415	Blackberry............	9.62	0.60	0.916	0.725	5.67	....	....	....	−1.1	−1.0	0.0
20418	Crab apple............	14.34	0.84	0.705	0.418	5.68	....	1.70	....	−0.7	−3.0	−0.8
20417	Grape (Ives seedling)...	12.50	0.75	....	....	6.11	....	0.29	. ..	−1.6	−2.0	0.0
20425	Orange (Florida navel) .	13.11	0.61	0.686	0.985	4.13	....	3.33	....	+2.0	2.5	0.8
20444	Pineapple	13.71	0.50	0 392	0.056	8.12	....	3.11	....	+1.0	−3.2	−0.0

[1] The composition here given is not that of the original fruit, but of the pulped mass used in the preparation of jams.

TABLE IV.—JAM.

Laboratory No.	Description of sample.	Total solids. Per cent.	Ash. Per cent.	Total acids calculated as H_2SO_4. Per cent.	Proteids ($N \times 6.25$). Per cent.	Sugars. Reducing sugars. Per cent.	Cane-sugar added. Per cent.	Cane-sugar found. Per cent.	Added cane-sugar inverted. Per cent.	Polarizations. Direct at 18° C.	Invert at 18° C.	Invert at 86° C.
20446	Apple (fall pippin).....	63.22	0.20	0.282	0.175	25.52	51.31	29.11	43.22	+ 26.3	— 13.0	+ 4.8
20414	Blackberry	55.42	0.48	0.851	0.737	18.77	43.99	29.00	34.08	+ 24.6	— 14.6	+ 1.6
20419	Crab apple.............	41.82	0.27	0.715	0.493	14.80	36.09	23.04	35.46	+ 18.3	— 12.8	— 0.6
20445	Grape (fox)	61.80	0.19	0.698	0.200	50.06	54.21	3.70	92.96	— 9.0	— 14.0	+ 2.2
20416	Grape (Ives seedling)..	56.64	0.48	0.744	0.525	33.44	42.45	11.33	73.38	+ 3.5	— 11.8	0.0
20443	Orange (Florida navel).	80.52	0.44	0.433	0.944	13.61	69.13	54.23	21.55	+ 55.9	— 17.5	+ 2.0
20448	Pear (Bartlett).........	61.52	0.28	0.163	0.312	13.20	46.52	33.74	18.87	+ 32.3	— 13.2	+ 1.0
20442	Pineapple marmalade) .	73.92	0.30	0.315	0.312	14.05	60.20	46.40	22.90	+ 52.3	— 10.3	+ 6.2
20421	Plum (Damson)	50.43	0.54	1.012	0.525	28.29	37.75	9.70	74.42	+ 3.1	— 10.0	+ 1.2
20423	Plum (wild fox).......	62.10	0.46	1.355	0.212	28.78	47.86	23.26	53.43	+ 13.9	— 17.5	0.0