filter paper in a Gooch crucible with suction. Wash twice with cold distilled water without allowing the precipitate to become dry. Transfer the precipitate to the original beaker, add water and heat to boiling. Titrate with 0.05*N* NaOH, using phenolphthalein as the indicator.

$9.6 \times \text{cc. } 0.05N \text{ NaOH} = \text{parts per million } \text{SO}_4$.

The benzidine hydrochloride solution is made up as follows: Place 8 g. of benzidine in an agate mortar and add enough water to make a paste. Wash the paste into a 1 liter flask, add 10 cc. concentrated HCl, and make up to the mark. Filter, if necessary. 1 cc. = 0.0026 g. SO_4 .

CONCLUSIONS

I—The benzidine hydrochloride method is applicable for the determination of sulfates in water.

II—The results with the use of benzidine hydrochloride compare favorably with those obtained with the use of barium chloride.

III—The benzidine hydrochloride method is much more rapid than the barium chloride method, for which reason it is very well adapted to routine water analysis.

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EXAMINATION OF TOMATO PULP

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Tomato pulp is prepared in very large quantities for the manufacture of ketchup and pulp. While a considerable amount of pulp used for this purpose is made by the ketchup manufacturers, the preparation of pulp for sale as such has reached considerable proportions. There is also an increasing amount of this product placed on the market in small containers for household use in the preparation of soup.

While the greater part of the pulp placed on the market is made from whole tomatoes, there are a number of plants that manufacture pulp from trimming stock in connection with the canning of tomatoes. Since the latter product is given a lower grade commercially than whole tomato pulp and has a somewhat different composition, it becomes important to be able to distinguish the two by examination in the laboratory.

It is found that the results of the samples examined in this laboratory during the last season afford a basis for this distinction. They also make it possible to simplify the examination which we have heretofore found necessary.

COMPOSITION OF WHOLE TOMATO PULP

The results obtained by the examination of 33 samples of whole tomato pulp are given in Table I. The concentration of the samples varies from unconcentrated pulp as it runs from the cyclone, to pulps of very heavy consistency. This table contains the data from which Table III and IV were calculated, although during the season a partial analysis was made of a large number of other samples, and the data secured therefrom were in all respects confirmatory of the relations calculated from Table I.

In addition to the data obtained by the various determinations, Table I gives the relation between the results of the determinations for each individual sample. For instance, the ratio of pulp solids to filtrate solids (pulp solids divided by filtrate solids) varies in the different samples from 1.091 to 1.154, and, with the exception of two samples, it varies from 1.100 to 1.145. The average of the 33 samples was 1.12. The relation of insoluble solids to total solids (expressed as per cent of insoluble solids in total solids) is shown in Table I. Considering the variations in the methods employed by different manufacturers in the preparation of tomato pulp, the per cent of insoluble solids in the total solids as shown by this column is closer than we might expect, varying in most of the samples from 11 to 14 per cent.

The per cent of sugar in the soluble solids, as shown by Table I, varies in most of the samples from 50 to 55 per cent. This figure cannot be expected to be constant in different localities and in different years.

The acid, estimated as citric, constitutes in most of the samples from 9 to 10 per cent of the soluble solids.

Of especial interest is the refractive constant of the filtered liquor, shown in the last column of Table I. The refractive constant of the various samples is much more uniform than might be expected from a product of this nature.

On the whole, Table I is chiefly interesting as affording the data from which Tables III and IV were calculated. The uniformity of the relations shown in Table IV is such that it is usually possible from one determination on the filtrate and the determination of solids in the pulp by drying to distinguish pulp made from whole tomatoes from that made from trimming stock. For instance, if the specific gravity or index of refraction of a filtrate prepared from a pulp of unknown origin, and the per cent of solids in the pulp by drying, do not agree with the relation between these determinations as shown in Table IV, it may be assumed that the sample was not prepared from whole tomatoes, or that some other substance, such as salt, has been added. Moreover, trimming stock pulp rarely conforms to the relations found in whole tomato pulp. For instance, the insoluble solids are usually higher and the acid lower in trimming stock pulp.

COMPOSITION OF TRIMMING STOCK PULP

In Table II are given the results of the examination of 21 typical samples of trimming stock pulp prepared at different plants and in different localities. This table is of especial interest in showing that the relations between the results of the various analytical determinations differ from those of whole tomato pulps as given in Table IV. For instance, in No. 1470 the immersion refractometer reading is 45.90, and the per cent of solids is 9.54, whereas, according to Table IV, the per cent of solids in the pulp corresponding to an index of refraction of 45.90 should be 8.57. The specific gravity of the pulp is 1.0373, which, according to Table IV, should correspond to 8.98 instead of 9.54. Of course it cannot be said definitely that a pulp

which on examination is found to conform to all the relations shown in Table IV is necessarily whole tomato pulp. It is entirely possible for an occasional sample of trimming stock pulp to conform to all the relations shown in that table; moreover, the extent to which different samples of trimming stock pulp will vary from the relations shown in Table IV differs with the manner of preparation. For instance, if a portion of the juice is discarded in the manufacture of trimming stock pulp, as is still the practice of some manufacturers, the variation from whole tomato pulp will be greater than otherwise and the variation will increase with the amount of juice discarded.

METHODS OF ANALYSIS

The methods given may also be applied to the examination of raw tomatoes and canned tomatoes. In applying the relations given below to the results obtained by the examination of tomato pulp

or cup for the determination of specific gravity, air bubbles are introduced which it is found impossible to remove without the aid of a centrifuge. These can be completely removed by whirling the specific gravity flask in a centrifuge for about one minute at a speed of about 1000 r. p. m. A hand Babcock milk tester is satisfactory for this purpose. This causes the pulp to settle into the flask, because of the elimination of the air bubbles. The flask is again filled and centrifuged; this is continued until the surface of the pulp remains at the top of the flask. A few drops of pulp are added to bring the contents above the top of the flask and the pulp is then "struck off" with a straight edge, the outside of the flask washed and dried and the flask and contents weighed.

A table can be constructed readily giving in parallel columns the weight of flask and contents and the specific gravity of the pulp. For the use of Table IV, the

TABLE I—COMPOSITION OF WHOLE TOMATO PULPS
FILTRATE FROM PULPS

SAMPLE NO.	COMPOSITION OF PULPS			FILTRATE FROM PULPS					Ratio of pulp solids to filtrate solids	Per cent insoluble solids in total solids	SOLIDS OF FILTRATE			Refractive constant of filtered liquor(f)
	Sp. gr. at 20° C.	Per cent total solids(a)	Per cent insoluble solids	Sp. gr. at 20° C.	Per cent solids(a)	Per cent sugar(d)	Per cent acid as citric	Immersion refractometer 17.5° C.			Percentages			
											Sugar	Acid	Ratio sugar to acid	
1290	1.0252	5.94	0.66	1.0233	5.24	2.41	0.58	36.24	1.133	11.1	46.0	11.1	4.1	0.20556
1291	1.0273	6.54	0.78	1.0252	5.71	3.10	0.53	37.80	1.145	11.9	54.3	9.4	5.8	0.20550
1292	1.0234	5.50	0.80	1.0211	4.88	2.48	0.49	34.51	1.127	14.6	50.8	10.1	5.0	0.20564
1293	1.0293	7.02	0.74	1.0276	6.28	3.35	0.61	40.04	1.118	10.5	53.4	9.7	5.5	0.20548
1294	1.0272	6.48	0.69	1.0256	5.82	3.20	0.55	38.27	1.113	10.6	55.0	9.5	5.8	0.20525
1295	1.0361	8.67	0.95	1.0340	7.69	4.36	0.67	46.03	1.127	11.0	56.8	8.7	6.5	0.20534
1296	1.0380	9.00	1.06	.....	8.05	4.47	0.66	46.86	1.117	11.8	55.5	8.2	6.8	.....
1297	1.0465	11.20	1.19	1.0446	10.27	5.61	0.89	56.70	1.091	10.6	54.6	8.9	6.3	0.20544
1299	1.0417	10.07	1.23	1.0394	9.09	4.96	0.81	51.75	1.108	12.2	54.6	8.9	6.1	0.20550
1300	1.0322	7.70	0.93	1.0304	6.88	3.55	0.67	42.84	1.119	12.1	51.6	9.7	5.3	0.20546
1301	1.0312	7.36	0.91	.....	6.68	3.27	0.69	41.56	1.102	12.4	48.9	10.3	4.8	.....
1302	1.0310	7.45	0.91	1.0293	6.61	3.43	0.64	41.76	1.127	12.2	51.9	9.7	5.4	0.20551
1303	1.0340	8.17	0.91	1.0323	7.29	3.77	0.71	44.65	1.120	11.1	51.7	9.7	5.3	0.20549
1304	1.0292	6.88	0.88	1.0274	6.20	3.03	0.64	39.74	1.110	12.8	48.9	10.4	4.7	0.20546
1305	1.0371	9.03	1.19	.....	7.98	4.14	0.82	47.30	1.132	13.2	51.9	10.3	5.0	.....
1306	1.0370	8.95	0.98	.....	8.01	4.71	0.69	47.60	1.117	11.0	58.8	8.7	6.8	.....
1307(b)	1.0328	7.86	1.01	1.0308	6.97	3.79	0.66	43.15	1.126	12.9	54.4	9.5	5.7	0.20544
1481	1.0449	10.82	.....	1.0421	9.64	5.15	0.99	54.20	1.123	.....	53.4	10.3	5.2	0.20545
1482	1.0444	10.83	.....	1.0422	9.86	5.62	0.94	54.75	1.100	.....	57.0	9.6	6.0	0.20554
1483	1.0464	11.21	.....	1.0441	10.19	5.67	0.98	56.45	1.100	.....	55.6	9.6	5.8	0.20550
1484	1.0423	10.27	.....	1.0396	9.23	5.42	0.81	52.10	1.114	.....	58.7	8.8	6.7	0.20544
1485	1.0347	8.55	.....	1.0332	7.73	4.35	0.72	45.85	1.106	.....	56.3	9.3	6.0	0.20529
1477(c)	1.0610	13.86	.....	1.0579	12.75	6.55	0.97	67.15	1.111(e)	.....	51.4	7.7	6.7	.....
1479	1.0411	10.00	1.21	1.0386	8.96	.....	.....	51.57	1.116	9.8	.....	.....	.....	0.20554
1486	1.0169	4.34	0.62	1.0158	3.76	.....	.....	.....	1.154	14.3	.....	.....	.....	.....
1491	1.0198	4.97	0.63	1.0188	4.40	.....	.....	32.67	1.128	12.7	.....	.....	.....	0.20565
1496	1.0341	8.27	1.15	1.0318	7.31	.....	.....	44.86	1.131	13.9	.....	.....	.....	0.20554
1515	1.0352	8.56	1.15	1.0331	7.61	.....	.....	46.20	1.125	13.5	.....	.....	.....	0.20556
1529	1.0209	5.11	0.89	1.0195	4.54	.....	.....	32.96	1.125	17.4	.....	.....	.....	0.20556
1530	1.0252	6.21	0.98	1.0231	5.42	.....	.....	36.31	1.145	15.8	.....	.....	.....	0.20553
1531	1.0291	7.17	1.08	1.0273	6.27	.....	.....	40.09	1.143	15.1	.....	.....	.....	0.20547
1224(c)	1.0486	11.22	0.91	1.0468	10.33	.....	.....	57.62	1.124(e)	11.8	.....	.....	.....	.....
1325	1.0327	7.86	0.93	.....	6.99	.....	.....	43.80	1.123	.....	.....	.....	.....	.....

(a) Determined by drying *in vacuo* at 70° C.
(b) Composite of 1290 to 1306 inclusive.

(c) This sample contained salt.
(d) Expressed as invert.

(e) Salt-free ratio.
(f) Calculated by formula of Lorentz-Lorenz, $\frac{n^2 - 1}{(n^2 + 2)^2}$.

or canned tomatoes, it is assumed that no substance such as sugar or salt has been added. If sodium chloride is found to be present in excess of the amount normal to tomatoes (from 0.05 to 0.1 per cent), it is necessary to determine the amount of salt and make correction therefor before applying the relations given below.

In examining raw tomatoes, care must be taken to secure a representative sample of the juice. This cannot be done by applying pressure directly, as the juice of the seed receptacles is of different composition from that of the fleshy part of the tomato. It is necessary, therefore, to crush the sample and thoroughly cook it in a flask surrounded by boiling water and connected with a reflux condenser.

DETERMINATION OF SPECIFIC GRAVITY

In pouring the sample of tomato pulp into a flask

specific gravity should be determined at 20° C. If the temperature varies from this, the specific gravity may be corrected by the correction table for Brix hydrometers, changing the Brix degrees in that table to the corresponding specific gravity, and also allowing for the fact that the correction table mentioned is based on 17 $\frac{1}{2}$ ° instead of 20° C.

DETERMINATION OF SOLIDS

I. BY THE EXAMINATION OF THE PULP—The total solids in tomato pulp may be determined by drying *in vacuo* at 70° C.; by drying at atmospheric pressure at the temperature of boiling water; by calculation from the specific gravity of the pulp; or from the percent of solids, specific gravity or index of refraction of the filtrate. The solids obtained by different methods on 31 samples of pulp are given in Table III.

(a). BY DRYING—By drying either *in vacuo* or at

atmospheric pressure, it is our experience that after the sample has reached apparent dryness, four hours' drying gives complete results. From 2 to 4 grams should be taken for the determination, and enough water added to distribute the sample uniformly over the bottom of the flat-bottomed dish.

The solids as determined by drying *in vacuo* at 70° C. are about 108.5 per cent of the result obtained by drying at the temperature of boiling water at atmospheric

only one case did it exceed 0.20 per cent. The results obtained by the subsequent examination of a considerable number of other samples confirm this relation.

(b). BY CALCULATION FROM THE SPECIFIC GRAVITY OF THE PULP—There is a very exact relation between the specific gravity of pulp (determined by the method given above) and the per cent of total solids as determined by drying. The solids corresponding to

TABLE II—COMPOSITION OF TRIMMING STOCK PULPS

COMPOSITION OF PULPS				COMPOSITION OF LIQUOR OBTAINED BY FILTERING PULPS				Ratio of pulp solids to filtrate solids	Per cent insoluble solids in total solids	Per cent sugar in solids of liquor	Per cent acid in solids of liquor	Ratio of acid to sugar
SAMPLE No.	Specific gravity at 20° C.	Per cent total solids(a)	Per cent insoluble solids	Specific gravity at 20° C.	Per cent solids(a)	Per cent sugar(e)	Per cent acid as citric	Immersion refractometer at 17.5° C.				
1470.....	1.0373	9.54	.....	1.0337	7.68	4.11	0.58	45.90	1.241	.....	53.5	7.6
1471.....	1.0385	9.40	.....	1.0334	7.62	4.05	0.59	45.75	1.233	.....	53.2	7.7
1470-1.....	1.0349	8.56	.....	1.0302	7.11	.....	.....	42.87	1.203	.....	.....	.....
1470-2.....	1.0316	7.88	.....	1.0279	6.55	.....	.....	40.75	1.203	.....	.....	.....
1470-3.....	1.0284	7.00	.....	.....	5.83	.....	.....	37.80	1.201	.....	.....	.....
1470-4.....	1.0258	6.62	.....	1.0232	5.53	.....	.....	36.40	1.197	.....	.....	.....
1471-1.....	1.0334	8.12	.....	1.0288	6.86	.....	.....	41.60	1.184	.....	.....	.....
1471-2.....	1.0258	6.41	.....	1.0227	5.41	.....	.....	36.10	1.184	.....	.....	.....
1471-3.....	1.0299	7.48	.....	1.0275	6.14	.....	.....	39.25	1.218	.....	.....	.....
1471-4.....	1.0191	4.74	.....	1.0168	3.94	.....	.....	30.35	1.203	.....	.....	.....
1572.....	1.0424	10.28	.....	1.0400	9.28	.....	.....	52.47	1.109	.....	.....	.....
1573.....	1.0392	9.53	1.22	1.0369	8.53	.....	.....	49.33	1.117	12.8	.....	.....
1574.....	1.0427	10.29	1.17	1.0401	9.29	.....	.....	52.40	1.109	11.4	.....	.....
1575.....	1.0386	9.73	1.29	1.0369	8.28	.....	.....	49.37	1.175	13.3	.....	.....
1662(b).....	1.0204	4.85	0.18	1.0201	4.65	.....	.....	33.27	1.042	3.7	.....	.....
1664(c).....	1.0577	13.2	0.62	1.0566	12.70	.....	.....	66.92	1.040	4.7	.....	.....
1665.....	1.0331	7.74	1.10	1.0304	6.89	.....	.....	42.65	1.123	14.3	.....	.....
701.....	1.0200	4.89	0.72	1.0184	4.29	2.35	0.30	32.09	1.140	14.7	54.8	7.0
703(d).....	1.0180	4.24	0.10	1.0178	4.15	2.32	0.29	32.09	1.022	2.4	55.9	7.0
705.....	1.0388	9.85	1.83	1.0359	8.08	4.07	0.51	47.85	1.220	18.6	50.4	6.2
706.....	1.0333	8.35	0.98	.....	7.29	3.51	0.46	44.69	1.145	11.7	48.3	6.3

(a) Determined by drying *in vacuo* at 70° C.

(b) Unconcentrated tomato juice from peeling table.

(c) No. 1662 concentrated.

(d) Clear liquor separated from unconcentrated pulp on standing.

(e) Expressed as invert.

pressure. This figure is the average of the results obtained by the examination of 20 samples of pulp, in all of which the per cent of solids obtained by drying *in vacuo* agree quite closely with the per cent

pulps of various specific gravities are given in Table IV, or may be obtained from the following formula which is derived from the same table:

Per cent Solids

$$= 228 (\text{sp. gr. of pulp} - 1.000) + 19.1 (\text{sp. gr. of pulp} - 1.015).$$

2. BY THE EXAMINATION OF THE FILTRATE—

If a sample of pulp of considerable size be thrown on a folded filter, a filtrate is obtained whose composition has a definite relation to that of the whole pulp.

(a). BY DRYING—The per cent of solids in the filtrate may be determined by drying *in vacuo* at 70° C., or under atmospheric pressure at the temperature of boiling water.

As in the case of the drying of pulp, a constant relation is found to exist between the per cent of solids as determined by drying *in vacuo* at 70° C., and the per cent of solids as determined by drying at atmospheric pressure at the temperature of boiling water. The per cent of solids in the filtrate obtained by drying at atmospheric pressure, multiplied by 1.125, gives the per cent of solids obtained by drying *in vacuo*. This relation is shown in detail in Table IV.

The per cent of solids in the filtered liquor obtained by drying *in vacuo*, multiplied by 1.12, gives the per cent of solids in the original pulp obtained by drying *in vacuo*. This relationship is shown in Table I, in the column headed "Ratio of pulp solids to filtrate solids," and also in Table IV.

Of the 33 samples shown in Table I, the result obtained by multiplying the per cent of solids in the filtrate (obtained by drying *in vacuo*) by the factor 1.12 is very nearly identical with the per cent of solids in the pulp (obtained by drying *in vacuo*). In 22 of the 33 samples the difference between these two figures is less than 0.1 per cent. In 17 samples it

TABLE III—COMPARISON OF METHODS FOR THE DETERMINATION AND CALCULATION OF SOLIDS IN WHOLE TOMATO PULP

SAMPLE No.	PER CENT SOLIDS IN LIQUOR FROM FILTERED PULP				PER CENT SOLIDS IN PULP CALCULATED FROM			
	Drying <i>in vacuo</i> at 70° C.	Refr. Table	Sp. gr. Table	Sp. gr. See (a)	By drying <i>in vacuo</i> at 70° C.	Refr. Table	Sp. gr. Table	Sp. gr. See (b)
1290	5.24	5.31	5.35	5.35	5.94	5.95	6.00	5.97
1291	5.71	5.67	5.78	5.80	6.54	6.36	6.48	6.47
1292	4.88	4.87	4.85	4.85	5.50	5.47	5.44	5.52
1293	6.28	6.21	6.33	6.35	7.02	6.96	7.10	6.98
1294	5.82	5.79	5.87	5.89	6.48	6.49	6.58	6.45
1295	7.69	7.67	7.82	7.82	8.67	8.59	8.77	8.63
1296	8.05	7.88	.....	.....	9.00	8.83	.....	9.11
1297	10.27	10.27	10.25	10.26	11.20	11.50	11.47	11.20
1299	9.09	9.06	9.05	9.06	10.07	10.15	10.14	10.02
1300	6.88	6.91	6.98	6.99	7.70	7.75	7.82	7.68
1301	6.68	6.59	.....	.....	7.36	7.38	.....	7.43
1302	6.61	6.64	6.73	6.74	7.45	7.44	7.54	7.40
1303	7.29	7.34	7.42	7.43	8.17	8.23	8.33	8.12
1304	6.20	6.16	6.30	6.30	6.88	6.90	7.06	6.95
1305	7.98	7.98	.....	.....	9.03	8.94	.....	8.88
1306	8.01	8.05	.....	.....	8.95	9.02	.....	8.86
1307	6.97	6.96	7.08	7.08	7.86	7.81	7.93	7.83
1481	9.64	9.67	9.68	9.68	10.82	10.83	10.84	10.80
1482	9.86	9.81	9.70	9.71	10.83	10.98	10.86	10.70
1483	10.19	10.21	10.15	10.14	11.21	11.43	11.36	11.17
1484	9.23	9.15	9.10	9.11	10.27	10.25	10.19	10.17
1485	7.73	7.64	7.63	7.64	8.55	8.56	8.55	8.30
1479	8.96	9.03	8.87	8.88	10.00	10.10	9.94	9.88
1486	3.76	.....	3.62	3.63	4.34	.....	4.05	3.90
1491	4.40	4.44	4.30	4.32	4.97	4.97	4.82	4.62
1496	7.31	7.39	7.30	7.31	8.27	8.28	8.18	8.15
1515	7.61	7.70	7.60	7.61	8.56	8.63	8.52	8.40
1529	4.54	4.52	4.47	4.49	5.11	5.06	5.01	4.90
1530	5.42	5.32	5.30	5.31	6.21	5.97	5.94	5.97
1531	6.27	6.25	6.27	6.28	7.17	7.01	7.04	6.92
1325	6.99	7.13	.....	.....	7.86	7.99	.....	7.81

(a) The solution factor of O'Sullivan (*J. Chem. Soc.*, 1876, p. 129) was employed with slight modification. The formula employed was $1000(d - 1.000) = \text{per cent solids}$. In this formula d = specific gravity of solution at 20° C.

(b) For the figures in this column the formula given in footnote (a) was employed and the results multiplied by 1.12.

obtained by drying at atmospheric pressure multiplied by 1.085. In 15 of the 20 samples examined, the difference did not exceed 0.10 per cent, and in

is less than 0.06 per cent, and in 13 samples it is less than 0.05 per cent. In only two samples does it exceed 0.17 per cent.

(b). BY CALCULATION FROM THE SPECIFIC GRAVITY OF THE FILTRATE—The specific gravity of the filtered liquor may be determined by means of an ordinary pycnometer. From the specific gravity at 20° C., the per cent of solids in the filtrate as determined by drying *in vacuo* at 70° C., may be obtained from

TABLE IV—TOMATO PULP AND FILTERED LIQUOR																													
FILTRATE FROM PULP					TOMATO PULP					FILTRATE FROM PULP					TOMATO PULP					FILTRATE FROM PULP					TOMATO PULP				
% solids, 70° C. <i>in vacuo</i>	% solids, 100° C. <i>in vacuo</i>	Immer- sion re- fractometer at 17.5° C.	Sp. gr. at 20° C.		% solids, 70° C. <i>in vacuo</i>	% solids, 100° C. <i>in vacuo</i>	Immer- sion re- fractometer at 17.5° C.	Sp. gr. at 20° C.		% solids, 70° C. <i>in vacuo</i>	% solids, 100° C. <i>in vacuo</i>	Immer- sion re- fractometer at 17.5° C.	Sp. gr. at 20° C.		% solids, 70° C. <i>in vacuo</i>	% solids, 100° C. <i>in vacuo</i>	Immer- sion re- fractometer at 17.5° C.	Sp. gr. at 20° C.		% solids, 70° C. <i>in vacuo</i>	% solids, 100° C. <i>in vacuo</i>	Immer- sion re- fractometer at 17.5° C.	Sp. gr. at 20° C.		% solids, 70° C. <i>in vacuo</i>	% solids, 100° C. <i>in vacuo</i>	Immer- sion re- fractometer at 17.5° C.	Sp. gr. at 20° C.	
3.05	2.71	26.9	1.0133		3.42	3.15	1.0150			6.30	5.60	40.3	1.0274		7.06	6.51	1.0297			9.30	8.27	52.7	1.0404		10.41	9.60	1.0433		
3.10	2.75	27.1	1.0136		3.47	3.20	1.0152			6.35	5.64	40.6	1.0277		7.12	6.56	1.0299			9.35	8.31	52.9	1.0406		10.47	9.65	1.0435		
3.15	2.80	27.3	1.0138		3.53	3.25	1.0155			6.40	5.69	40.8	1.0279		7.17	6.61	1.0301			9.40	8.35	53.1	1.0409		10.52	9.70	1.0437		
3.20	2.85	27.5	1.0140		3.58	3.30	1.0157			6.45	5.73	41.0	1.0281		7.23	6.66	1.0304			9.45	8.40	53.3	1.0411		10.58	9.75	1.0440		
3.25	2.89	27.7	1.0142		3.64	3.35	1.0159			6.50	5.78	41.2	1.0283		7.28	6.71	1.0306			9.50	8.45	53.5	1.0413		10.64	9.80	1.0442		
3.30	2.93	27.9	1.0144		3.70	3.41	1.0161			6.55	5.82	41.4	1.0285		7.34	6.76	1.0308			9.55	8.49	53.7	1.0415		10.70	9.86	1.0444		
3.35	2.97	28.1	1.0146		3.76	3.46	1.0163			6.60	5.86	41.6	1.0287		7.40	6.82	1.0310			9.60	8.53	53.9	1.0417		10.75	9.91	1.0447		
3.40	3.02	28.3	1.0149		3.81	3.51	1.0166			6.65	5.91	41.8	1.0290		7.45	6.87	1.0313			9.65	8.58	54.1	1.0419		10.80	9.96	1.0449		
3.45	3.07	28.6	1.0151		3.87	3.56	1.0168			6.70	5.95	42.0	1.0292		7.51	6.92	1.0315			9.70	8.62	54.3	1.0422		10.86	10.01	1.0451		
3.50	3.11	28.8	1.0153		3.92	3.61	1.0170			6.75	6.00	42.2	1.0294		7.56	6.97	1.0317			9.75	8.67	54.5	1.0424		10.91	10.06	1.0453		
3.55	3.15	29.0	1.0155		3.98	3.67	1.0172			6.80	6.04	42.4	1.0296		7.62	7.02	1.0320			9.80	8.71	54.7	1.0426		10.97	10.11	1.0456		
3.60	3.20	29.2	1.0157		4.03	3.72	1.0174			6.85	6.09	42.6	1.0298		7.68	7.08	1.0322			9.85	8.75	55.0	1.0428		11.02	10.16	1.0458		
3.65	3.24	29.4	1.0160		4.09	3.77	1.0177			6.90	6.14	42.8	1.0300		7.74	7.13	1.0324			9.90	8.80	55.2	1.0430		11.08	10.21	1.0461		
3.70	3.28	29.6	1.0162		4.15	3.82	1.0179			6.95	6.18	43.1	1.0303		7.79	7.18	1.0326			9.95	8.85	55.4	1.0433		11.14	10.26	1.0463		
3.75	3.33	29.8	1.0164		4.20	3.87	1.0181			7.00	6.22	43.3	1.0305		7.85	7.23	1.0329			10.00	8.89	55.6	1.0435		11.20	10.31	1.0465		
3.80	3.38	30.0	1.0166		4.26	3.93	1.0183			7.05	6.26	43.5	1.0307		7.90	7.28	1.0331			10.05	8.93	55.8	1.0437		11.25	10.37	1.0467		
3.85	3.42	30.3	1.0168		4.31	3.98	1.0185			7.10	6.31	43.7	1.0309		7.96	7.33	1.0333			10.10	8.98	56.0	1.0439		11.30	10.42	1.0469		
3.90	3.46	30.5	1.0170		4.37	4.03	1.0188			7.15	6.36	43.9	1.0311		8.02	7.38	1.0336			10.15	9.02	56.2	1.0441		11.36	10.47	1.0472		
3.95	3.51	30.7	1.0173		4.43	4.08	1.0190			7.20	6.40	44.1	1.0313		8.07	7.43	1.0338			10.20	9.07	56.4	1.0444		11.41	10.52	1.0474		
4.00	3.55	30.9	1.0175		4.48	4.13	1.0192			7.25	6.44	44.3	1.0315		8.12	7.48	1.0340			10.25	9.11	56.6	1.0446		11.47	10.57	1.0476		
4.05	3.60	31.1	1.0177		4.54	4.18	1.0194			7.30	6.48	44.5	1.0318		8.18	7.54	1.0342			10.30	9.15	56.8	1.0448		11.53	10.63	1.0478		
4.10	3.64	31.3	1.0179		4.59	4.23	1.0197			7.35	6.53	44.7	1.0320		8.24	7.59	1.0345			10.35	9.20	57.0	1.0450		11.59	10.68	1.0481		
4.15	3.69	31.5	1.0181		4.65	4.28	1.0199			7.40	6.58	44.9	1.0322		8.30	7.64	1.0348			10.40	9.25	57.2	1.0452		11.64	10.73	1.0483		
4.20	3.73	31.7	1.0183		4.71	4.33	1.0201			7.45	6.62	45.1	1.0324		8.35	7.69	1.0349			10.45	9.29	57.4	1.0454		11.70	10.78	1.0485		
4.25	3.78	31.9	1.0185		4.76	4.38	1.0203			7.50	6.66	45.3	1.0326		8.40	7.74	1.0352			10.50	9.33	57.6	1.0457		11.75	10.83	1.0487		
4.30	3.82	32.1	1.0188		4.82	4.44	1.0205			7.55	6.71	45.5	1.0328		8.46	7.79	1.0354			10.55	9.38	57.8	1.0459		11.81	10.89	1.0490		
4.35	3.86	32.3	1.0190		4.87	4.49	1.0208			7.60	6.76	45.7	1.0331		8.52	7.84	1.0356			10.60	9.42	58.0	1.0461		11.87	10.94	1.0492		
4.40	3.91	32.5	1.0192		4.93	4.54	1.0210			7.65	6.80	45.9	1.0333		8.57	7.89	1.0358			10.65	9.47	58.2	1.0463		11.93	10.99	1.0494		
4.45	3.95	32.7	1.0194		4.99	4.59	1.0212			7.70	6.84	46.2	1.0335		8.63	7.95	1.0361			10.70	9.51	58.4	1.0465		11.99	11.04	1.0496		
4.50	4.00	32.9	1.0196		5.04	4.64	1.0215			7.75	6.88	46.4	1.0337		8.68	8.00	1.0363			10.75	9.55	58.6	1.0467		12.05	11.09	1.0499		
4.55	4.04	33.1	1.0198		5.10	4.70	1.0217			7.80	6.93	46.6	1.0339		8.74	8.05	1.0365			10.80	9.60	58.8	1.0469		12.10	11.15	1.0501		
4.60	4.09	33.3	1.0200		5.16	4.75	1.0219			7.85	6.98	46.8	1.0341		8.80	8.11	1.0367			10.85	9.65	59.0	1.0471		12.15	11.20	1.0503		
4.65	4.13	33.6	1.0203		5.21	4.80	1.0222			7.90	7.02	47.0	1.0344		8.86	8.16	1.0370			10.90	9.70	59.2	1.0474		12.21	11.25	1.0505		
4.70	4.18	33.8	1.0205		5.27	4.85	1.0224			7.95	7.07	47.2	1.0346		8.91	8.21	1.0372			10.95	9.74	59.4	1.0476		12.26	11.30	1.0508		
4.75	4.22	34.0	1.0207		5.33	4.90	1.0226			8.00	7.11	47.4	1.0348		8.96	8.26	1.0374			11.00	9.78	59.6	1.0478		12.32	11.35	1.0510		
4.80	4.26	34.2	1.0209		5.38	4.96	1.0228			8.05	7.16	47.6	1.0350		9.02	8.31	1.0377			11.05	9.82	59.9	1.0480		12.37	11.40	1.0512		
4.85	4.31	34.4	1.0211		5.44	5.01	1.0230			8.10	7.20	47.8	1.0352		9.08	8.36	1.0379			11.10	9.87	60.1	1.0482		12.43	11.45	1.0515		
4.90	4.36	34.6	1.0213		5.49	5.06	1.0233			8.15	7.24	48.0	1.0354		9.14	8.41	1.0381			11.15	9.92	60.3	1.0484		12.49	11.50	1.0517		
4.95	4.40	34.8	1.0216		5.55	5.11	1.0235			8.20	7.28	48.2	1.0357		9.19	8.46	1.0383			11.20	9.96	60.5	1.0487		12.55	11.55	1.0519		
5.00	4.44	35.0	1.0218		5.60	5.16	1.0237			8.25	7.33	48.4	1.0359		9.25	8.51	1.0386			11.25	10.00	60.7	1.0489		12.60	11.60	1.0522		
5.05	4.49	35.2	1.0220		5.66	5.21	1.0240			8.30	7.38	48.6	1.0361		9.30	8.57	1.0388			11.30	10.04	60.9	1.0491		12.65	11.66	1.0524		
5.10	4.53	35.4	1.0223		5.72	5.26	1.0242			8.35	7.42	48.8	1.0363		9.36	8.62	1.0390			11.35	10.09	61.1	1.0493		12.71	11.71	1.0526		
5.15	4.58	35.6	1.0225		5.77	5.31	1.0244		</																				

it permits of much greater accuracy. The corresponding percentage of solids in the filtrate and the percentage of solids in the pulp from which it is prepared may be ascertained from the index of refraction by Table IV. The per cent of solids in the filtrate may also be calculated from the scale reading of the immersion refractometer at 17.5° C., by the following formula, which is derived from Table IV:

$$\text{Per cent Solids in Filtrate} = 0.238 (\text{scale reading} - 15) - 0.0165 (\text{scale reading} - 26.4).$$

If the index of refraction has been determined by means of an Abbé refractometer, the per cent of solids in the filtrate may be calculated by the following formula:

$$\text{Per cent Solids in Filtrate} = 666 (n_D - 1.3332) - 20.7 (n_D - 1.3376).$$

The per cent of total solids in tomato pulp may also be ascertained from the index of refraction of the liquor prepared by filtering the pulp as shown in Table IV; or, it may be calculated from the immersion refractometer reading by the following formula, which is derived from Table IV:

$$\text{Per cent Solids in Pulp} = 0.289 (\text{scale reading of filtrate} - 15) - 0.0185 (\text{scale reading} - 26.4).$$

If the index of refraction of the filtrate has been determined by means of an Abbé refractometer, the per cent of solids in the pulp may be calculated by the following formula:

$$\text{Per cent Solids in Pulp} = 748 (n_D - 1.3332) - 25.5 (n_D - 1.3376).$$

It is of interest to note that the relation between the index of refraction of the liquor obtained by filtering tomato pulp and the per cent of solids in that liquid is very similar to the relation between the index of refraction and dissolved solids in beer and wine extract, as shown in the table prepared by Wagner.¹

In the formula given above, as well as in Table IV, it is assumed that salt is absent. If it be desired to calculate the percentage of solids in a sample containing salt from the index of refraction of the filtrate, it is necessary first to determine the amount of salt present and make correction therefor. For this purpose the table of Wagner² may be employed.

This correction is necessary, however, if the percentage of solids be determined by drying, or calculated from specific gravity.

DETERMINATION OF INSOLUBLE SOLIDS

Transfer 20 grams of the pulp to an eight-ounce nursing bottle, nearly filled with hot water, mix by shaking, and centrifuge until the insoluble matter is collected in a cake in the bottom of the bottle. Transfer the supernatant liquor onto a double, tared filter paper covering the bottom of a Büchner funnel, using suction to facilitate filtration.

Again fill the nursing bottle with hot water, stir the cake of insoluble solids so that it is thoroughly mixed with the water, centrifuge, and decant the supernatant liquor on the filter. Repeat the centrifuging and the filtration of the supernatant liquor once more, and then finally transfer the insoluble solids to the filter paper and thoroughly wash with hot water. Dry the paper and insoluble solids, and weigh. The insoluble solids are quite hygroscopic and the weight must be taken quickly.

¹ "Ueber quantitative Bestimmungen wässriger Lösungen mit dem Zeiss-schen Eintauchrefraktometer," Table XVII.

² *Ibid.*, Table I.

DETERMINATION OF SUGAR

The sugar of tomatoes is probably always present as invert sugar. If cane sugar is ever present in the raw product it is doubtless inverted during the concentration of pulp. The per cent of sugar given in Tables I and II was determined by the method of Munson and Walker.¹

DETERMINATION OF ACIDITY

Accurate results cannot be obtained by the titration of tomato products in the presence of the insoluble solids. If it be desired to determine the acidity in the entire sample of tomatoes or tomato pulp rather than in the expressed juice, the insoluble solids should first be removed by the method given in the determination of insoluble solids. The per cent of acid given in Tables I and II was obtained by titrating the liquor obtained by filtering the pulp. In products of this nature, the addition of an alkali causes a brownish color which has a tendency to obscure the end point shown by the indicator. To obviate this, the sample should be diluted to at least 200 cc. and a larger amount of indicator employed than is necessary with a clear solution. The following details are suggested:

Dilute 20 grams of the filtrate under examination with over 200 cc. of water. Add at least 1/2 cc. of phenolphthalein solution (prepared by dissolving 1 gram of phenolphthalein in 100 cc. of 95 per cent alcohol) and titrate with sodium hydroxide until the end point is obtained. Add 1 cc. of tenth-normal hydrochloric acid, heat the solution quickly to boiling and boil one minute to expel carbon dioxide. Cool the solution quickly to about room temperature, and then add tenth-normal sodium hydroxide until the end point is obtained. The volume of hydrochloric acid added must, of course, be taken into consideration in the final result.

NATIONAL CANNERS' ASSOCIATION, WASHINGTON, D. C.

A CONCISE GROUP METHOD FOR THE DETECTION OF GELATINIZING AGENTS, PASTY MATERIAL AND THICKENERS, USED IN FOOD PRODUCTS

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The extreme difficulty of detecting various gelatinizing agents, pasty material and thickeners used in food products, has led the writer to work out a group method, by which these substances can be identified even if the unknown contains one or all of the common substances used for gelatinizing agents, etc., such as starch, dextrin, gelatine, acacia, agar-agar, tragacanth, albumen and pectin bodies of the fruit juices. The use of these substances has been quite general in recent years. Hence a study of these materials and their detection in food products is important to the chemist. Thickeners, pasty materials, and gelatinizing agents frequently are used to cheapen the genuine articles of food. In this class may be mentioned agar-agar, which has been found in imitation lemon slices; starch, agar-agar, and gelatine in imitation jelly; dextrin in imitation cocoa cubes. These materials are also used to cover up inferiority. In this class might be mentioned albumen, or white

¹ Bureau of Chemistry, U. S. Dept. Agr., *Bull.* 107, revised.