General

The result from a refractometer determination should be distinguished from that obtained by direct determination.

Principle

The dry soluble solids content of a sample is estimated from its refractive index, with reference to the refractive index of a pure sugar solution. The refractive index is proportional to the solution concentration (following the theory of Lorentz and Lorenz). In fruit juices the refractive index is therefore dependent upon sugar concentration and also upon the concentration of other soluble materials (organic acids, minerals, amino acids etc.)

WORKING INSTRUCTIONS

1. Apparatus

Refractometer (Abbe type)
- Scale divisions to at least 0,1% sucrose
- Exact temperature control to 20 °C ± 0,5 °C
- Calibration before each set of measurements, following the manufacturers' instructions

2. Experimental procedure

2.1 Sample preparation

Cloudy juices should be well mixed and then filtered before the determination. Concentrates should be thoroughly homogenised and then measured without further preparation.

2.2 Determination

Bring the sample to a temperature of ca. 20 °C (± 0,5 °C). This temperature should be checked before every measurement.

Place a small portion of the sample on the lower prism of the refractometer. Ensure that the sample covers the glass surface evenly, before clamping the prisms together. Wait for the sample to reach thermal equilibrium (ca. 30 secs) and then take the measurement according to the apparatus instructions. It is important to keep the temperature constant during the measurement.

The percentage sucrose content is read directly to the nearest 0,1%. At least two determinations should be made on the same sample.

3. Calculation

The content of soluble solids is usually expressed in grams of sucrose per 100 g of material. The result given is the percentage sugar according to the refractometric method. The value is read directly.
In citrus juices and other juices containing high amounts of citric acid such as blackcurrant, a so-called 'acid correction' is usually made. The following addition is made to the refractometer reading:

$$0{,}012 + 0{,}193x - 0{,}0004 \cdot x^2$$

where x = % total acid (pH 8,1), expressed as anhydrous citric acid (IFFJP method no. 3). The calculated values for this expression are given in Table A.

4. Statement of result

The result is given as Soluble Solids (refr.) in g/100 g or°Brix, to one decimal place. If an acid correction has been applied, this should be indicated with the suffix «corr.»

5. Reliability of the method

Using apricot and tomato juice as an example:

		Apricot juice	Tomato juice
	=		
Mean	x	14,0 %	5,5 %
Repeatability	r	0,14 %	0,16 %
	s_r	0,0518	0,0574
Reproducibility	R	0,45 %	0,39 %
	s_R	0,1592	0,1406

6. References

Method 30,00-2 of the Official Collection of Analytical Methods according to §35 LMBG (German Office of Public Health)

JAOAC 66, 371 (1983)

AOAC; Official Methods of Analysis (1990): 932.14/C

Table A: Acid Correction to the Brix value (Bx°) for high acid (Citrus) concentrates.

The correction values given are added to the refractometer values (expressed in °Bx = grams of sucrose / 100 grams of sample), obtained at 20°C.

Total Acid (pH 8.1) expressed as citric acid (g acid / 100 g concentrate)	Correction Value
0.2	0.04
0.4	0.08
0.6	0.12
0.8	0.16
1.0	0.20
1.2	0.24
1.4	0.28
1.6	0.32
1.8	0.36
2.0	0.39
2.2	0.43
2.4	0.47
2.6	0.51
2.8	0.54
3.0	0.58
3.2	0.62
3.4	0.66
3.6	0.70
3.8	0.74
4.0	0.78
4.2	0.81
4.4	0.85
4.6	0.89
4.8	0.93
5.0	0.97
5.2	1.01
5.4	1.04
5.6	1.07
5.8	1.11
6.0	1.15

Total Acid (pH 8.1) expressed as citric acid (g acid / 100 g concentrate)	Correction Value
6.2	1.19
6.4	1.23
6.6	1.27
6.8	1.31
7.0	1.34
7.2	1.38
7.4	1.42
7.6	1.46
7.8	1.5
8.0	1.54
8.2	1.58
8.4	1.62
8.6	1.66
8.8	1.69
9.0	1.72
9.2	1.76
9.4	1.80
9.6	1.83
9.8	1.87
10.0	1.91
10.2	1.95
10.4	1.99
10.6	2.03
10.8	2.06
11.0	2.10
11.2	2.14
11.4	2.18
11.6	2.21
11.8	2.24
12.0	2.27
12.2	2.31
12.4	2.35
12.6	2.39
12.8	2.42
13.0	2.46

Total Acid (pH 8.1) expressed as citric acid (g acid / 100 g concentrate)	Correction Value
13.2	2.50
13.4	2.54
13.6	2.57
13.8	2.61
14.0	2.64
14.2	2.68
14.4	2.72
14.6	2.75
14.8	2.78
15.0	2.81
15.2	2.84
15.4	2.89
15.6	2.93
15.8	2.97
16.0	3.00
16.2	3.03
16.4	3.06
16.6	3.09
16.8	3.13
17.0	3.17
17.2	3.21
17.4	3.25
17.6	3.28
17.8	3.31
18.0	3.35
18.2	3.38
18.4	3.42
18.6	3.46
18.8	3.49
19.0	3.53
19.2	3.56
19.4	3.59
19.6	3.63
19.8	3.67
20.0	3.70

Total Acid (pH 8.1) expressed as citric acid (g acid / 100 g concentrate)	Correction Value
20.2	3.73
20.4	3.77
20.6	3.80
20.8	3.84
21.0	3.88
21.2	3.91
21.4	3.95
21.6	3.99
21.8	4.02
22.0	4.05
22.2	4.09
22.4	4.13
22.6	4.17
22.8	4.20
23.0	4.24
23.2	4.27
23.4	4.30
23.6	4.34
23.8	4.38
24.0	4.41
24.2	4.44
24.4	4.48
24.6	4.51
24.8	4.54
25.0	4.58
25.2	4.62
25.4	4.66
25.6	4.69
25.8	4.73
26.0	4.76
26.2	4.79
26.4	4.83
26.6	4.86
26.8	4.90
27.0	4.94

Total Acid (pH 8.1) expressed as citric acid (g acid / 100 g concentrate)	Correction Value
27.2	4.97
27.4	5.00
27.6	5.03
27.8	5.06
28.0	5.10
28.2	5.14
28.4	5.18
28.6	5.22
28.8	5.25
29.0	5.28
29.2	5.31
29.4	5.35
29.6	5.39
29.8	5.42
30.0	5.46
30.2	5.49
30.4	5.53
30.6	5.57
30.8	5.60
31.0	5.64
31.2	5.67
31.4	5.70
31.6	5.74
31.8	5.77
32.0	5.80
32.2	5.84
32.4	5.87
32.6	5.90
32.8	5.94
33.0	5.97
33.2	6.00
33.4	6.04
33.6	6.07
33.8	6.10
34.0	6.14

Total Acid (pH 8.1) expressed as citric acid (g acid / 100 g concentrate)	Correction Value
34.2	6.17
34.4	6.20
34.6	6.24

Table B. Relationship between °Brix (percent sucrose by weight), relative density ($D_{20/20}$) and total solids (kg/m^3, equivalent to g/litre)

°Brix	$D_{20/20}$	Total Solids kg/m^3
0.0	1.00000	0.00
0.1	1.00039	1.00
0.2	1.00077	2.00
0.3	1.00116	2.99
0.4	1.00155	3.99
0.5	1.00194	5.00
0.6	1.00233	6.00
0.7	1.00271	7.00
0.8	1.00310	8.00
0.9	1.00349	9.01
1.0	1.00388	10.01
1.1	1.00427	11.02
1.2	1.00466	12.02
1.3	1.00505	13.03
1.4	1.00544	14.04
1.5	1.00583	15.04
1.6	1.00622	16.05
1.7	1.00661	17.06
1.8	1.00701	18.07
1.9	1.00740	19.09
2.0	1.00779	20.10
2.1	1.00818	21.11
2.2	1.00857	22.13
2.3	1.00897	23.14
2.4	1.00936	24.16
2.5	1.00975	25.17
2.6	1.01015	26.19
2.7	1.01054	27.21
2.8	1.01093	28.23
2.9	1.01133	29.25
3.0	1.01172	30.27
3.1	1.01212	31.29
3.2	1.01251	32.31
3.3	1.01291	33.33
3.4	1.01330	34.35
3.5	1.01370	35.38
3.6	1.01410	36.40
3.7	1.01449	37.43
3.8	1.01489	38.46
3.9	1.01529	39.48
4.0	1.01568	40.51

°Brix	$D_{20/20}$	Total Solids kg/m^3
4.1	1.01608	41.54
4.2	1.01648	42.57
4.3	1.01688	43.60
4.4	1.01728	44.63
4.5	1.01767	45.67
4.6	1.01807	46.70
4.7	1.01847	47.73
4.8	1.01887	48.77
4.9	1.01927	49.80
5.0	1.01967	50.84
5.1	1.02007	51.88
5.2	1.02047	52.91
5.3	1.02087	53.95
5.4	1.02127	54.99
5.5	1.02168	56.03
5.6	1.02208	57.07
5.7	1.02248	58.12
5.8	1.02288	59.16
5.9	1.02328	60.20
6.0	1.02369	61.25
6.1	1.02409	62.29
6.2	1.02449	63.34
6.3	1.02490	64.39
6.4	1.02530	65.43
6.5	1.02571	66.48
6.6	1.02611	67.53
6.7	1.02651	68.58
6.8	1.02692	69.63
6.9	1.02732	70.69
7.0	1.02773	71.74
7.1	1.02814	72.79
7.2	1.02854	73.85
7.3	1.02895	74.90
7.4	1.02936	75.96
7.5	1.02976	77.01
7.6	1.03017	78.07
7.7	1.03058	79.13
7.8	1.03098	80.19
7.9	1.03139	81.25
8.0	1.03180	82.31

°Brix	$D_{20/20}$	Total Solids kg/m^3
8.1	1.03221	83.37
8.2	1.03262	84.44
8.3	1.03303	85.50
8.4	1.03344	86.56
8.5	1.03385	87.63
8.6	1.03426	88.69
8.7	1.03467	89.76
8.8	1.03508	90.83
8.9	1.03549	91.90
9.0	1.03590	92.97
9.1	1.03631	94.04
9.2	1.03672	95.11
9.3	1.03714	96.18
9.4	1.03755	97.25
9.5	1.03796	98.33
9.6	1.03838	99.40
9.7	1.03879	100.48
9.8	1.03920	101.55
9.9	1.03962	102.63
10.0	1.04003	103.71
10.1	1.04044	104.79
10.2	1.04086	105.87
10.3	1.04127	106.95
10.4	1.04169	108.03
10.5	1.04210	109.11
10.6	1.04252	110.19
10.7	1.04294	111.28
10.8	1.04335	112.36
10.9	1.04377	113.45
11.0	1.04419	114.54
11.1	1.04460	115.62
11.2	1.04502	116.71
11.3	1.04544	117.80
11.4	1.04586	118.89
11.5	1.04628	119.98
11.6	1.04670	121.07
11.7	1.04712	122.17
11.8	1.04754	123.26
11.9	1.04795	124.35
12.0	1.04837	125.45

°Brix	$D_{20/20}$	Total Solids kg/m^3
12.1	1.04880	126.55
12.2	1.04922	127.64
12.3	1.04964	128.74
12.4	1.05006	129.84
12.5	1.05048	130.94
12.6	1.05090	132.04
12.7	1.05132	133.14
12.8	1.05175	134.24
12.9	1.05217	135.35
13.0	1.05259	136.45
13.1	1.05302	137.56
13.2	1.05344	138.66
13.3	1.05386	139.77
13.4	1.05429	140.88
13.5	1.05471	141.98
13.6	1.05514	143.09
13.7	1.05556	144.20
13.8	1.05599	145.31
13.9	1.05641	146.43
14.0	1.05684	147.54
14.1	1.05727	148.65
14.2	1.05769	149.77
14.3	1.05812	150.88
14.4	1.05855	152.00
14.5	1.05897	153.12
14.6	1.05940	154.24
14.7	1.05983	155.35
14.8	1.06026	156.47
14.9	1.06069	157.60
15.0	1.06112	158.72
15.1	1.06155	159.84
15.2	1.06198	160.96
15.3	1.06241	162.09
15.4	1.06284	163.21
15.5	1.06327	164.34
15.6	1.06370	165.47
15.7	1.06413	166.60
15.8	1.06456	167.73
15.9	1.06499	168.86
16.0	1.06543	169.99

°Brix	$D_{20/20}$	Total Solids kg/m^3
16.1	1.06586	171.12
16.2	1.06629	172.25
16.3	1.06672	173.38
16.4	1.06716	174.52
16.5	1.06759	175.65
16.6	1.06802	176.79
16.7	1.06846	177.93
16.8	1.06889	179.07
16.9	1.06933	180.21
17.0	1.06976	181.35
17.1	1.07020	182.49
17.2	1.07064	183.63
17.3	1.07107	184.77
17.4	1.07151	185.92
17.5	1.07195	187.06
17.6	1.07238	188.21
17.7	1.07282	189.35
17.8	1.07326	190.50
17.9	1.07370	191.65
18.0	1.07414	192.80
18.1	1.07457	193.95
18.2	1.07501	195.10
18.3	1.07545	196.25
18.4	1.07589	197.40
18.5	1.07633	198.56
18.6	1.07677	199.71
18.7	1.07721	200.87
18.8	1.07765	202.03
18.9	1.07810	203.18
19.0	1.07854	204.34
19.1	1.07898	205.50
19.2	1.07942	206.66
19.3	1.07986	207.82
19.4	1.08031	208.99
19.5	1.08075	210.15
19.6	1.08119	211.32
19.7	1.08164	212.48
19.8	1.08208	213.65
19.9	1.08253	214.81
20.0	1.08297	215.98

°Brix	$D_{20/20}$	Total Solids kg/m^3
20.1	1.08342	217.15
20.2	1.08386	218.32
20.3	1.08431	219.49
20.4	1.08475	220.66
20.5	1.08520	221.84
20.6	1.08565	223.01
20.7	1.08610	224.19
20.8	1.08654	225.36
20.9	1.08699	226.54
21.0	1.08744	227.72
21.1	1.08789	228.90
21.2	1.08834	230.08
21.3	1.08878	231.26
21.4	1.08923	232.44
21.5	1.08968	233.62
21.6	1.09013	234.80
21.7	1.09058	235.99
21.8	1.09103	237.17
21.9	1.09149	238.36
22.0	1.09194	239.55
22.1	1.09239	240.74
22.2	1.09284	241.93
22.3	1.09329	243.12
22.4	1.09375	244.31
22.5	1.09420	245.50
22.6	1.09465	246.69
22.7	1.09511	247.89
22.8	1.09556	249.08
22.9	1.09601	250.28
23.0	1.09647	251.48
23.1	1.09692	252.67
23.2	1.09738	253.87
23.3	1.09783	255.07
23.4	1.09829	256.27
23.5	1.09875	257.48
23.6	1.09920	258.68
23.7	1.09966	259.88
23.8	1.10012	261.09
23.9	1.10058	262.29
24.0	1.10103	263.50

°Brix	$D_{20/20}$	Total Solids kg/m^3
24.1	1.10149	264.71
24.2	1.10195	265.92
24.3	1.10241	267.13
24.4	1.10287	268.34
24.5	1.10333	269.55
24.6	1.10379	270.76
24.7	1.10425	271.98
24.8	1.10471	273.19
24.9	1.10517	274.41
25.0	1.10563	275.63
25.1	1.10609	276.84
25.2	1.10656	278.06
25.3	1.10702	279.28
25.4	1.10748	280.50
25.5	1.10794	281.73
25.6	1.10841	282.95
25.7	1.10887	284.17
25.8	1.10933	285.40
25.9	1.10980	286.63
26.0	1.11026	287.85
26.1	1.11073	289.08
26.2	1.11119	290.31
26.3	1.11166	291.54
26.4	1.11212	292.77
26.5	1.11259	294.00
26.6	1.11306	295.24
26.7	1.11352	296.47
26.8	1.11399	297.71
26.9	1.11446	298.94
27.0	1.11493	300.18
27.1	1.11540	301.42
27.2	1.11587	302.66
27.3	1.11633	303.90
27.4	1.11680	305.14
27.5	1.11727	306.38
27.6	1.11774	307.63
27.7	1.11821	308.87
27.8	1.11868	310.12
27.9	1.11916	311.36
28.0	1.11963	312.61

°Brix	$D_{20/20}$	Total Solids kg/m^3
28.1	1.12010	313.86
28.2	1.12057	315.11
28.3	1.12104	316.36
28.4	1.12152	317.61
28.5	1.12199	318.86
28.6	1.12246	320.12
28.7	1.12294	321.37
28.8	1.12341	322.63
28.9	1.12389	323.88
29.0	1.12436	325.14
29.1	1.12484	326.40
29.2	1.12531	327.66
29.3	1.12579	328.92
29.4	1.12626	330.19
29.5	1.12674	331.45
29.6	1.12722	332.71
29.7	1.12769	333.98
29.8	1.12817	335.25
29.9	1.12865	336.51
30.0	1.12913	337.78
30.1	1.12961	339.05
30.2	1.13009	340.32
30.3	1.13057	341.59
30.4	1.13104	342.87
30.5	1.13152	344.14
30.6	1.13201	345.41
30.7	1.13249	346.69
30.8	1.13297	347.97
30.9	1.13345	349.25
31.0	1.13393	350.52
31.1	1.13441	351.81
31.2	1.13490	353.09
31.3	1.13538	354.37
31.4	1.13586	355.65
31.5	1.13634	356.94
31.6	1.13683	358.22
31.7	1.13731	359.51
31.8	1.13780	360.80
31.9	1.13828	362.09
32.0	1.13877	363.38

°Brix	$D_{20/20}$	Total Solids kg/m^3
32.1	1.13925	364.67
32.2	1.13974	365.96
32.3	1.14023	367.25
32.4	1.14071	368.55
32.5	1.14120	369.84
32.6	1.14169	371.14
32.7	1.14218	372.44
32.8	1.14266	373.73
32.9	1.14315	375.03
33.0	1.14364	376.33
33.1	1.14413	377.64
33.2	1.14462	378.94
33.3	1.14511	380.24
33.4	1.14560	381.55
33.5	1.14609	382.86
33.6	1.14658	384.16
33.7	1.14707	385.47
33.8	1.14756	386.78
33.9	1.14806	388.09
34.0	1.14855	389.40
34.1	1.14904	390.72
34.2	1.14953	392.03
34.3	1.15003	393.34
34.4	1.15052	394.66
34.5	1.15102	395.98
34.6	1.15151	397.30
34.7	1.15200	398.62
34.8	1.15250	399.94
34.9	1.15300	401.26
35.0	1.15349	402.58
35.1	1.15399	403.90
35.2	1.15448	405.23
35.3	1.15498	406.56
35.4	1.15548	407.88
35.5	1.15598	409.21
35.6	1.15647	410.54
35.7	1.15697	411.87
35.8	1.15747	413.20
35.9	1.15797	414.54
36.0	1.15847	415.87

°Brix	$D_{20/20}$	Total Solids kg/m^3
36.1	1.15897	417.21
36.2	1.15947	418.54
36.3	1.15997	419.88
36.4	1.16047	421.22
36.5	1.16097	422.56
36.6	1.16148	423.90
36.7	1.16198	425.24
36.8	1.16248	426.58
36.9	1.16298	427.93
37.0	1.16349	429.27
37.1	1.16399	430.62
37.2	1.16449	431.97
37.3	1.16500	433.32
37.4	1.16550	434.67
37.5	1.16601	436.02
37.6	1.16651	437.37
37.7	1.16702	438.72
37.8	1.16752	440.08
37.9	1.16803	441.43
38.0	1.16854	442.79
38.1	1.16904	444.15
38.2	1.16955	445.51
38.3	1.17006	446.87
38.4	1.17057	448.23
38.5	1.17108	449.59
38.6	1.17158	450.95
38.7	1.17209	452.32
38.8	1.17260	453.68
38.9	1.17311	455.05
39.0	1.17362	456.42
39.1	1.17413	457.79
39.2	1.17465	459.16
39.3	1.17516	460.53
39.4	1.17567	461.90
39.5	1.17618	463.28
39.6	1.17669	464.65
39.7	1.17721	466.03
39.8	1.17772	467.41
39.9	1.17823	468.79
40.0	1.17875	470.17

°Brix	$D_{20/20}$	Total Solids kg/m^3
40.1	1.17926	471.55
40.2	1.17978	472.93
40.3	1.18029	474.31
40.4	1.18081	475.70
40.5	1.18132	477.08
40.6	1.18184	478.47
40.7	1.18236	479.86
40.8	1.18287	481.25
40.9	1.18339	482.64
41.0	1.18391	484.03
41.1	1.18443	485.42
41.2	1.18494	486.82
41.3	1.18546	488.21
41.4	1.18598	489.61
41.5	1.18650	491.01
41.6	1.18702	492.41
41.7	1.18754	493.81
41.8	1.18806	495.21
41.9	1.18858	496.61
42.0	1.18911	498.01
42.1	1.18963	499.42
42.2	1.19015	500.82
42.3	1.19067	502.23
42.4	1.19119	503.64
42.5	1.19172	505.05
42.6	1.19224	506.46
42.7	1.19276	507.87
42.8	1.19329	509.28
42.9	1.19381	510.70
43.0	1.19434	512.11
43.1	1.19486	513.53
43.2	1.19539	514.95
43.3	1.19592	516.37
43.4	1.19644	517.79
43.5	1.19697	519.21
43.6	1.19750	520.63
43.7	1.19802	522.06
43.8	1.19855	523.48
43.9	1.19908	524.91
44.0	1.19961	526.34

°Brix	$D_{20/20}$	Total Solids kg/m^3
44.1	1.20014	527.77
44.2	1.20067	529.20
44.3	1.20120	530.63
44.4	1.20173	532.06
44.5	1.20226	533.49
44.6	1.20279	534.93
44.7	1.20332	536.36
44.8	1.20385	537.80
44.9	1.20439	539.24
45.0	1.20492	540.68
45.1	1.20545	542.12
45.2	1.20598	543.56
45.3	1.20652	545.01
45.4	1.20705	546.45
45.5	1.20759	547.90
45.6	1.20812	549.35
45.7	1.20866	550.79
45.8	1.20919	552.24
45.9	1.20973	553.70
46.0	1.21026	555.15
46.1	1.21080	556.60
46.2	1.21134	558.06
46.3	1.21187	559.51
46.4	1.21241	560.97
46.5	1.21295	562.43
46.6	1.21349	563.89
46.7	1.21403	565.35
46.8	1.21457	566.81
46.9	1.21511	568.27
47.0	1.21565	569.74
47.1	1.21619	571.21
47.2	1.21673	572.67
47.3	1.21727	574.14
47.4	1.21781	575.61
47.5	1.21835	577.08
47.6	1.21889	578.55
47.7	1.21944	580.03
47.8	1.21998	581.50
47.9	1.22052	582.98
48.0	1.22107	584.46

°Brix	$D_{20/20}$	Total Solids kg/m^3
48.1	1.22161	585.93
48.2	1.22216	587.41
48.3	1.22270	588.90
48.4	1.22325	590.38
48.5	1.22379	591.86
48.6	1.22434	593.35
48.7	1.22488	594.83
48.8	1.22543	596.32
48.9	1.22598	597.81
49.0	1.22653	599.30
49.1	1.22707	600.79
49.2	1.22762	602.28
49.3	1.22817	603.78
49.4	1.22872	605.27
49.5	1.22927	606.77
49.6	1.22982	608.27
49.7	1.23037	609.77
49.8	1.23092	611.27
49.9	1.23147	612.77
50.0	1.23202	614.27
50.1	1.23257	615.77
50.2	1.23313	617.28
50.3	1.23368	618.79
50.4	1.23423	620.29
50.5	1.23478	621.80
50.6	1.23534	623.31
50.7	1.23589	624.83
50.8	1.23845	626.34
50.9	1.23700	627.85
51.0	1.23756	629.37
51.1	1.23811	630.89
51.2	1.23867	632.41
51.3	1.23922	633.92
51.4	1.23978	635.45
51.5	1.24034	636.97
51.6	1.24089	638.49
51.7	1.24145	640.02
51.8	1.24201	641.54
51.9	1.24257	643.07
52.0	1.24313	644.60

°Brix	$D_{20/20}$	Total Solids kg/m^3
52.1	1.24369	646.13
52.2	1.24425	647.66
52.3	1.24481	649.19
52.4	1.24537	650.73
52.5	1.24593	652.26
52.6	1.24649	653.80
52.7	1.24705	655.34
52.8	1.24761	656.88
52.9	1.24817	658.42
53.0	1.24874	659.96
53.1	1.24930	661.50
53.2	1.24986	663.05
53.3	1.25043	664.59
53.4	1.25099	666.14
53.5	1.25156	667.69
53.6	1.25212	669.24
53.7	1.25269	670.79
53.8	1.25325	672.34
53.9	1.25382	673.90
54.0	1.25439	675.45
54.1	1.25495	677.01
54.2	1.25552	678.57
54.3	1.25609	680.13
54.4	1.25666	681.69
54.5	1.25722	683.25
54.6	1.25779	684.81
54.7	1.25836	686.38
54.8	1.25893	687.94
54.9	1.25950	689.51
55.0	1.26007	691.08
55.1	1.26064	692.65
55.2	1.26121	694.22
55.3	1.26179	695.80
55.4	1.26236	697.37
55.5	1.26293	698.95
55.6	1.26350	700.52
55.7	1.26408	702.10
55.8	1.26465	703.68
55.9	1.26522	705.26
56.0	1.26580	706.84

°Brix	$D_{20/20}$	Total Solids kg/m^3
56.1	1.26637	708.43
56.2	1.26695	710.01
56.3	1.26752	711.60
56.4	1.26810	713.19
56.5	1.26867	714.77
56.6	1.26925	716.37
56.7	1.26983	717.96
56.8	1.27040	719.55
56.9	1.27098	721.14
57.0	1.27156	722.74
57.1	1.27214	724.34
57.2	1.27272	725.94
57.3	1.27330	727.54
57.4	1.27388	729.14
57.5	1.27446	730.74
57.6	1.27504	732.34
57.7	1.27562	733.95
57.8	1.27620	735.56
57.9	1.27678	737.17
58.0	1.27736	738.78
58.1	1.27794	740.39
58.2	1.27853	742.00
58.3	1.27911	743.61
58.4	1.27969	745.23
58.5	1.28028	746.84
58.6	1.28086	748.46
58.7	1.28144	750.08
58.8	1.28203	751.70
58.9	1.28261	753.33
59.0	1.28320	754.95
59.1	1.28379	756.57
59.2	1.28437	758.20
59.3	1.28496	759.83
59.4	1.28555	761.46
59.5	1.28614	763.09
59.6	1.28672	764.72
59.7	1.28731	766.35
59.8	1.28790	767.99
59.9	1.28849	769.62
60.0	1.28908	771.26

°Brix	$D_{20/20}$	Total Solids kg/m^3
60.1	1.28967	772.90
60.2	1.29026	774.54
60.3	1.29085	776. 18
60.4	1.29144	777.83
60.5	1.29203	779.47
60.6	1.29262	781.12
60.7	1.29322	782.76
60.8	1.29381	784.41
60.9	1.29440	786.06
61.0	1.29500	787.71
61.1	1.29559	789.37
61.2	1.29618	791.02
61.3	1.29678	792.68
61.4	1.29737	794.34
61.5	1.29797	795.99
61.6	1.29856	797.65
61.7	1.29916	799.32
61.8	1.29976	800.98
61.9	1.30035	802.64
62.0	1.30095	804.31
62.1	1.30155	805.98
62.2	1.30215	807.65
62.3	1.30274	809.32
62.4	1.30334	810.99
62.5	1.30394	812.66
62.6	1.30454	814.34
62.7	1.30514	816.01
62.8	1.30574	817.69
62.9	1.30634	819.37
63.0	1.30694	821.05
63.1	1.30755	822.73
63.2	1.30815	824.41
63.3	1.30875	826. 10
63.4	1.30935	827.78
63.5	1.30996	829.47
63.6	1.31056	831.16
63.7	1.31116	832.85
63.8	1.31177	834.54
63.9	1.31237	836.24
64.0	1.31298	837.93

°Brix	$D_{20/20}$	Total Solids kg/m^3
64.1	1.31358	839.63
64.2	1.31419	841.32
64.3	1.31479	843.02
64.4	1.31540	844.72
64.5	1.31601	846.43
64.6	1.31661	848.13
64.7	1.31722	849.83
64.8	1.31783	851.54
64.9	1.31844	853.25
65.0	1.31905	854.96
65.1	1.31966	856.67
65.2	1.32027	858.38
65.3	1.32088	860.09
65.4	1.32149	861.81
65.5	1.32210	863.53
65.6	1.32271	865.24
65.7	1.32332	866.96
65.8	1.32393	868.69
65.9	1.32454	870.41
66.0	1.32516	872.13
66.1	1.32577	873.86
66.2	1.32638	875.58
66.3	1.32700	877.31
66.4	1.32761	879.04
66.5	1.32823	880.77
66.6	1.32884	882.51
66.7	1.32946	884.24
66.8	1.33007	885.98
66.9	1.33069	887.71
67.0	1.33130	889.45
67.1	1.33192	891.19
67.2	1.33254	892.94
67.3	1.33316	894.68
67.4	1.33377	896.42
67.5	1.33439	898.17
67.6	1.33501	899.92
67.7	1.33563	901.67
67.8	1.33625	903.42
67.9	1.33687	905.17
68.0	1.33749	906.92

°Brix	$D_{20/20}$	Total Solids kg/m^3
68.1	1.33811	908.68
68.2	1.33873	910.44
68.3	1.33935	912.19
68.4	1.33998	913.95
68.5	1.34060	915.71
68.6	1.34122	917.48
68.7	1.34184	919.24
68.8	1.34247	921.01
68.9	1.34309	922.77
69.0	1.34372	924.54
69.1	1.34434	926.31
69.2	1.34497	928.09
69.3	1.34559	929.86
69.4	1.34622	931.63
69.5	1.34684	933.41
69.6	1.34747	935.19
69.7	1.34810	936.97
69.8	1.34872	938.75
69.9	1.34935	940.53
70.0	1.34998	942.31
70.1	1.35061	944.10
70.2	1.35124	945.89
70.3	1.35187	947.68
70.4	1.35249	949.47
70.5	1.35312	951.26
70.6	1.35376	953.05
70.7	1.35439	954.84
70.8	1.35502	956.64
70.9	1.35565	958.44
71.0	1.35628	960.24
71.1	1.35691	962.04
71.2	1.35755	963.84
71.3	1.35818	965.64
71.4	1.35881	967.45
71.5	1.35945	969.26
71.6	1.36008	971.90
71.7	1.36071	972.87
71.8	1.36135	974.69
71.9	1.36198	976.50
72.0	1.36262	978.31

°Brix	$D_{20/20}$	Total Solids kg/m^3
72.1	1.36326	980.13
72.2	1.36389	981.95
72.3	1.36453	983.77
72.4	1.36517	985.59
72.5	1.36580	987.41
72.6	1.36644	989.23
72.7	1.36708	991.90
72.8	1.36772	992.89
72.9	1.36836	994.71
73.0	1.36900	996.54
73.1	1.36964	998.38
73.2	1.37028	1000.21
73.3	1.37092	1002.04
73.4	1.37156	1003.88
73.5	1.37220	1005.72
73.6	1.37284	1007.56
73.7	1.37349	1009.40
73.8	1.37413	1011.24
73.9	1.37477	1013.08
74.0	1.37541	1014.93
74.1	1.37606	1016.78
74.2	1.37670	1018.63
74.3	1.37735	1020.48
74.4	1.37799	1022.33
74.5	1.37864	1024.18
74.6	1.37928	1026.04
74.7	1.37993	1027.89
74.8	1.38058	1029.75
74.9	1.38122	1031.61
75.0	1.38187	1033.47
75.1	1.38252	1035.34
75.2	1.38316	1037.20
75.3	1.38381	1039.07
75.4	1.38446	1040.93
75.5	1.38511	1042.80
75.6	1.38576	1044.67
75.7	1.38641	1046.55
75.8	1.38706	1048.42
75.9	1.38771	1050.30
76.0	1.38836	1052.17

°Brix	$D_{20/20}$	Total Solids kg/m^3
76.1	1.38901	1054.05
76.2	1.38966	1055.93
76.3	1.39032	1057.81
76.4	1.39097	1059.70
76.5	1.39162	1061.58
76.6	1.39228	1063.47
76.7	1.39293	1065.36
76.8	1.39358	1067.25
76.9	1.39424	1069.14
77.0	1.39489	1071.03
77.1	1.39555	1072.93
77.2	1.39620	1074.82
77.3	1.39686	1076.72
77.4	1.39751	1078.62
77.5	1.39817	1080.52
77.6	1.39883	1082.42
77.7	1.39949	1084.33
77.8	1.40014	1086.23
77.9	1.40080	1088.14
78.0	1.40146	1090.05
78.1	1.40212	1091.96
78.2	1.40278	1093.87
78.3	1.40344	1095.79
78.4	1.40410	1097.70
78.5	1.40476	1099.62
78.6	1.40542	1101.54
78.7	1.40608	1103.46
78.8	1.40674	1105.38
78.9	1.40740	1107.30
79.0	1.40807	1109.23
79.1	1.40873	1111.15
79.2	1.40939	1113.08
79.3	1.41005	1115.01
79.4	1.41072	1116.94
79.5	1.41138	1118.88
79.6	1.41205	1120.81
79.7	1.41271	1122.75
79.8	1.41338	1124.69
79.9	1.41404	1126.63
80.0	1.41471	1128.57

°Brix	$D_{20/20}$	Total Solids kg/m^3
80.1	1.41538	1130.51
80.2	1.41604	1132.46
80.3	1.41671	1134.40
80.4	1.41738	1136.35
80.5	1.41804	1138.30
80.6	1.41871	1140.25
80.7	1.41938	1142.20
80.8	1.42005	1144.16
80.9	1.42072	1146.11
81.0	1.42139	1148.07
81.1	1.42206	1150.03
81.2	1.42278	1151.99
81.3	1.42340	1153.96
81.4	1.42407	1155.92
81.5	1.42474	1157.89
81.6	1.42542	1159.85
81.7	1.42609	1161.82
81.8	1.42676	1163.79
81.9	1.42743	1165.76
82.0	1.42811	1167.74
82.1	1.42878	1169.72
82.2	1.42946	1171.69
82.3	1.43013	1173.67
82.4	1.43081	1175.65
82.5	1.43148	1177.63
82.6	1.43216	1179.62
82.7	1.43283	1181.60
82.8	1.43351	1183.59
82.9	1.43419	1185.58
83.0	1.43486	1187.57
83.1	1.43554	1189.56
83.2	1.43622	1191.56
83.3	1.43690	1193.55
83.4	1.43758	1195.55
83.5	1.43826	1197.55
83.6	1.43893	1199.55
83.7	1.43961	1201.55
83.8	1.44029	1203.56
83.9	1.44097	1205.56
84.0	1.44166	1207.57

°Brix	$D_{20/20}$	Total Solids kg/m^3
84.1	1.44234	1209.58
84.2	1.44302	1211.59
84.3	1.44370	1213.60
84.4	1.44438	1215.61
84.5	1.44507	1217.63
84.6	1.44575	1219.65
84.7	1.44643	1221.67
84.8	1.44712	1223.69
84.9	1.44780	1225.71
85.0	1.44849	1227.73
85.1	1.44917	1229.76
85.2	1.44986	1231.79
85.3	1.45054	1233.81
85.4	1.45123	1235.85
85.5	1.45191	1237.88
85.6	1.45260	1239.91
85.7	1.45329	1241.95
85.8	1.45397	1243.98
85.9	1.45466	1246.02
86.0	1.45535	1248.07
86.1	1.45604	1250.11
86.2	1.45673	1252.15
86.3	1.45742	1254.20
86.4	1.45811	1256.24
86.5	1.45880	1258.29
86.6	1.45949	1260.34
86.7	1.46018	1262.40
86.8	1.46087	1264.45
86.9	1.46156	1266.51
87.0	1.46225	1268.57
87.1	1.46295	1270.62
87.2	1.46364	1272.69
87.3	1.46433	1274.75
87.4	1.46502	1276.81
87.5	1.46572	1278.88
87.6	1.46641	1280.95
87.7	1.46711	1283.02
87.8	1.46780	1285.09
87.9	1.46850	1287.16
88.0	1.46919	1289.24

°Brix	$D_{20/20}$	Total Solids kg/m^3
88.1	1.46989	1291.31
88.2	1.47058	1293.39
88.3	1.47128	1295.47
88.4	1.47198	1297.55
88.5	1.47268	1299.63
88.6	1.47337	1301.72
88.7	1.47407	1303.81
88.8	1.47477	1305.89
88.9	1.47547	1307.98
89.0	1.47617	1310.08
89.1	1.47687	1312.17
89.2	1.47757	1314.26
89.3	1.47827	1316.36
89.4	1.47897	1318.46
89.5	1.47967	1320.56
89.6	1.48037	1322.66
89.7	1.48107	1324.77
89.8	1.48177	1326.87
89.9	1.48248	1328.98
90.0	1.48318	1331.09
90.1	1.48388	1333.20
90.2	1.48458	1335.31
90.3	1.48529	1337.43
90.4	1.48599	1339.54
90.5	1.48670	1341.66
90.6	1.48740	1343.78
90.7	1.48811	1345.90
90.8	1.48881	1348.02
90.9	1.48952	1350.15
91.0	1.49022	1352.27
91.1	1.49093	1354.40
91.2	1.49164	1356.53
91.3	1.49235	1358.66
91.4	1.49305	1360.79
91.5	1.49376	1362.93
91.6	1.49447	1365.07
91.7	1.49518	1367.20
91.8	1.49589	1369.34
91.9	1.49660	1371.49
92.0	1.49731	1373.63

°Brix	$D_{20/20}$	Total Solids kg/m^3
92.1	1.49802	1375.77
92.2	1.49873	1377.92
92.3	1.49945	1380.07
92.4	1.50015	1382.22
92.5	1.50086	1384.37
92.6	1.50157	1386.53
92.7	1.50229	1388.68
92.8	1.50300	1390.84
92.9	1.50371	1393.00
93.0	1.50442	1395.16
93.1	1.50514	1397.32
93.2	1.50585	1399.49
93.3	1.50657	1401.65
93.4	1.50728	1403.82
93.5	1.50800	1405.99
93.6	1.50871	1408.16
93.7	1.50943	1410.34
93.8	1.51014	1412.51
93.9	1.51086	1414.69
94.0	1.51158	1416.87
94.1	1.51229	1419.05
94.2	1.51301	1421.23
94.3	1.51373	1423.41
94.4	1.51445	1425.60
94.5	1.51517	1427.79
94.6	1.51588	1429.97
94.7	1.51660	1432.16
94.8	1.51732	1434.36
94.9	1.51804	1436.55
95.0	1.51876	1438.75
95.1	1.51948	1440.95
95.2	1.52021	1443.15
95.3	1.52093	1445.35
95.4	1.52165	1447.55
95.5	1.52237	1449.76
95.6	1.52309	1451.96
95.7	1.52382	1454.17
95.8	1.52454	1456.38
95.9	1.52526	1458.59
96.0	1.52599	1460.81

°Brix	$D_{20/20}$	Total Solids kg/m^3
96.1	1.52671	1463.02
96.2	1.52743	1465.24
96.3	1.52816	1467.46
96.4	1.52888	1469.68
96.5	1.52961	1471.90
96.6	1.53034	1474.13
96.7	1.53106	1476.35
96.8	1.53179	1478.58
96.9	1.53251	1480.81
97.0	1.53324	1483.04
97.1	1.53397	1485.27
97.2	1.53470	1487.51
97.3	1.53542	1489.75
97.4	1.53615	1491.99
97.5	1.53688	1494.23
97.6	1.53761	1496.47
97.7	1.53834	1498.71
97.8	1.53907	1500.96
97.9	1.53980	1503.20
98.0	1.54053	1505.45

°Brix	$D_{20/20}$	Total Solids kg/m^3
98.1	1.54126	1507.71
98.2	1.54199	1509.96
98.3	1.54273	1512.21
98.4	1.54346	1514.47
98.5	1.54419	1516.73
98.6	1.54492	1518.99
98.7	1.54565	1521.25
98.8	1.54639	1523.51
98.9	1.54712	1525.78
99.0	1.54786	1528.05
99.1	1.54859	1530.31
99.2	1.54932	1532.59
99.3	1.55006	1534.86
99.4	1.55079	1537.13
99.5	1.55153	1539.41
99.6	1.55227	1541.69
99.7	1.55300	1543.97
99.8	1.55374	1546.25
99.9	1.55447	1548.53
100.0	1.55521	1550.82

The table is adapted from those in appearing in Fruit Juice Processing Technology (AGSCIENCE Inc., Auburndale, Florida, 1993) and is reproduced by kind permission of the authors, S. Nagy, C. S. Chen and P. E. Shaw. The data was calculated from mathematical expressions developed by Chen (1989) based on density tables produced by Plato (1900):

CHEN, C. S. 1989. Mathematical correlations for calculation of Brix-apparent density of sucrose solutions. Lebensm.-Wiss. Technol. 22, 154-156.

PLATO, F. 1900. Kaiserlich Normaleichungs Kommission Wissenschaftliche Abhandlungen. 2, 153