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Invert Sugar

Invert Sugar Syrup

CAS RN[®]: 8013-17-0.

DEFINITION

Invert Sugar is an aqueous solution of inverted or partly inverted, refined or partly refined sucrose containing dextrose (glucose), fructose, and sucrose. It is produced by the hydrolysis or partial hydrolysis of sucrose with suitable acids or enzymes. Total Invert Sugar contains NLT 90.0% of dextrose and fructose, and medium Invert Sugar contains NLT 45.0% and NMT 55.0% of dextrose and fructose, both calculated on the total solids basis.

IDENTIFICATION

• A.

Mobile phase: Acetonitrile and water (80:20, v/v)

Standard solution: 10 mg/mL each of [USP Fructose RS](#), [USP Dextrose RS](#), and [USP Sucrose RS](#)

Sample solution: 50 mg/mL of Invert Sugar

Chromatographic system

(See [Chromatography \(621\)](#), [System Suitability](#).)

Mode: LC

Detector: Refractive index

Column: 4.6-mm × 15-cm; 5-μm packing L8

Temperatures

Column: 45°

Detector: 40°

Flow rate: 2.0 mL/min

Injection volume: 15 μL

Analysis

Samples: *Standard solution* and *Sample solution*

[NOTE—The relative retention times for fructose, dextrose, and sucrose are about 0.5, 0.6, and 1.0, respectively.]

Compare the retention times for fructose, dextrose, and sucrose given in the two chromatograms.

Acceptance criteria: The retention times of the fructose, dextrose, and sucrose peaks of the *Sample solution* correspond to those of the *Standard solution*.

ASSAY

• PROCEDURE

Apparatus: Mount a ring support on a ring stand 1–2 in above a gas burner and mount a second ring 6–7 in above the first. Place a 6-in open-wire gauze on the lower ring to support a 400-mL conical flask, and place a 4-in watch glass with a center hole on the upper ring to deflect heat. Attach a 50-mL buret to the ring stand so that the tip just passes through the watch glass centered above the flask. Place an indirectly lighted white surface behind the assembly for observing the endpoint.

Sample solution: 2.5–4.0 mg/mL of Invert Sugar

Analysis: Conduct a preliminary test to ascertain the volume of water to be added to the 20.0 mL of standardized cupric tartrate, alkaline, solution VS to obtain a final total volume of 75.0 mL when the endpoint of the titration is reached. The invert sugar content of the *Sample solution* should be between 250 and 400 mg per 100.0 mL so that a titer between 25 and 40 mL is needed to achieve the endpoint. Calculate the amount of water to be added to the cupric tartrate, alkaline, solution VS as the difference:

Result = 75.0 – (20.0 mL of cupric tartrate, alkaline, solution VS + number of mL of preliminary titer)

Transfer 20.0 mL of cupric tartrate, alkaline, solution VS to a 400-mL flask containing a few glass beads or boiling chips. Rapidly add the *Sample solution* to within 0.5 mL of the endpoint, and mix by swirling at ambient temperature. Immediately place the flask on the wire gauze of the *Apparatus*, and adjust the burner flame so that the boiling point of the solution is reached in about 2 min. Boil gently but steadily for 2 min. As boiling continues, add 3–4 drops of methylene blue solution (1 in 100). Complete the titration within 1 min by adding the *Sample solution* dropwise until the blue color disappears. Allow a 5-s reaction time between drops at the end of titration. Calculate the percentage of invert sugar in the sample taken:

$$P_1 = [W/(C_s \times V_s)] \times 100$$

W = amount of invert sugar equivalent to 20.0 mL of cupric tartrate, alkaline, solution VS, 100 mg

C_s = concentration of the *Sample solution* (mg/mL)

V_s = volume of the *Sample solution* used in the titration (mL)

Calculate the percentage of invert sugar on the total solids basis:

$$P_2 = (P_1/D) \times 100$$

D = percentage of total solids corrected for the percentage of invert sugar and temperature as obtained in *Total Solids*

Acceptance criteria

Total Invert Sugar: NLT 90.0% of dextrose and fructose on the total solids basis

Medium Invert Sugar: 45.0%–55.0% of dextrose and fructose on the total solids basis

IMPURITIES

• RESIDUE ON IGNITION (281).

Analysis: Weigh a portion of Invert Sugar in a platinum dish. Heat gently until the sample ignites, then allow the sample to burn until it self-extinguishes. Cool, then wet the residue with 2 mL of concentrated sulfuric acid, and heat the sample over a low flame until dry. Ignite to constant weight in a muffle furnace at $800 \pm 25^\circ$ for 30 min, or longer if necessary for complete ignition; cool in a desiccator; and weigh.

Acceptance criteria: NMT 0.2%

SPECIFIC TESTS

• pH (791): 3.0–5.5

• TOTAL SOLIDS

Instrumental conditions

(See [Refractive Index \(831\)](#).)

Mode: Refractometer, operating at 589 nm, equipped with a jacket for water circulation or some other mechanism for maintaining the sample at $20 \pm 0.1^\circ$ or some other fixed temperature. Before proceeding with measurements, ensure that the sample and the prism have reached the equilibrium temperature and that the instrument has been properly checked and calibrated against a standard provided by the manufacturer.

Analysis: Measure the refractive index of Invert Sugar, and convert the value to the approximate percentage of solids (uncorrected for invert sugar) by using [Table 1](#). Correct for invert sugar and temperature:

$$D = (S + T) + (P_1 \times F)$$

S = approximate percent solids determined from the refractive index table (see [Table 1](#))

T = temperature correction derived from the temperature correction table (see [Table 2](#)) if the refractometer was operated at other than 20°

P_1 = percentage of invert sugar determined as directed in the Assay

F = deWhalley factor, 0.022

Table 1^a

Sucrose (g/100 g)^b	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
56	1.4329	4332	4334	4336	4338	4340	4343	4345	4347	4349
57	1.4352	4354	4356	4358	4360	4363	4365	4367	4369	4372
58	1.4374	4376	4378	4380	4383	4385	4387	4389	4392	4394
59	1.4396	4398	4401	4403	4405	4407	4410	4412	4414	4417
60	1.4419	4421	4423	4426	4428	4430	4432	4435	4437	4439
61	1.4442	4444	4446	4448	4451	4453	4455	4458	4460	4462
62	1.4464	4467	4469	4471	4474	4476	4478	4481	4483	4485
63	1.4488	4490	4492	4495	4497	4499	4502	4504	4506	4509
64	1.4511	4513	4516	4518	4520	4523	4525	4527	4530	4532
65	1.4534	4537	4539	4541	4544	4546	4548	4551	4553	4556
66	1.4558	4560	4563	4565	4567	4570	4572	4575	4577	4579
67	1.4582	4584	4586	4589	4591	4594	4596	4598	4601	4603
68	1.4606	4608	4610	4613	4615	4618	4620	4623	4625	4627
69	1.4630	4632	4635	4637	4639	4642	4644	4647	4649	4652
70	1.4654	4657	4659	4661	4664	4666	4669	4671	4674	4676
71	1.4679	4681	4683	4686	4688	4691	4693	4696	4698	4701
72	1.4703	4706	4708	4711	4713	4716	4718	4721	4723	4726
73	1.4728	4730	4733	4735	4738	4740	4743	4745	4748	4750
74	1.4753	4756	4758	4761	4763	4766	4768	4771	4773	4776
75	1.4778	4781	4783	4786	4788	4791	4793	4796	4798	4801
76	1.4804	4806	4809	4811	4814	4816	4819	4821	4824	4826
77	1.4829	4832	4834	4837	4839	4842	4844	4847	4850	4852
78	1.4855	4857	4860	4862	4865	4868	4870	4873	4875	4878
79	1.4881	4883	4886	4888	4891	4894	4896	4899	4901	4904
80	1.4907	4909	4912	4914	4917	4920	4922	4925	4928	4930
81	1.4933	4935	4938	4941	4943	4946	4949	4951	4954	4957
82	1.4959	4962	4964	4967	4970	4972	4975	4978	4980	4983
83	1.4986	4988	4991	4994	4996	4999	5002	5004	5007	5010

Sucrose (g/100 g) ^b	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
84	1.5012	5015	5018	5020	5023	5026	5029	5031	5034	5037
85	1.5039	—	—	—	—	—	—	—	—	—

^a SOURCE: "International Refractive Index Scale of ICUMSA (1974) for Pure Sucrose Solutions at 20°C and 589 nm." Adapted from "Refractometry and Tables—Official" (ICUMSA SPS-3 1994), International Commission for Uniform Methods of Sugar Analysis (ICUMSA), c/o British Sugar Technical Centre, Colney, Norwich NR4 7UB, England. No rounding has been carried out; therefore, values given may be too low by a maximum of 1×10^{-4} .

^b The refractive index of sugar solutions is used as a rapid method for the approximate determination of dry substance content. For the determination of dry substance content in aqueous solutions of mixtures of sucrose and invert sugar the *Refractive Index Scale for Pure Sucrose Solutions* is typically used. The sucrose content is considered to be an equivalent to the approximate dry substance content.

Table 2^a

Temperature (°)	Measured Sucrose (% solids)																	
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
Subtract from the measured value																		
15	0.2 9	0.3 0	0.3 2	0.3 3	0.3 4	0.3 5	0.3 6	0.3 7	0.3 7	0.3 8	0.3 8	0.3 8	0.3 8	0.3 8	0.3 8	0.3 8	0.3 7	0.3 7
16	0.2 4	0.2 5	0.2 6	0.2 7	0.2 8	0.2 8	0.2 9	0.3 0	0.3 0	0.3 0	0.3 1	0.3 1	0.3 1	0.3 1	0.3 1	0.3 0	0.3 0	0.3 0
17	0.1 8	0.1 9	0.2 0	0.2 0	0.2 1	0.2 1	0.2 2	0.2 2	0.2 3	0.2 3	0.2 3	0.2 3	0.2 3	0.2 3	0.2 3	0.2 3	0.2 3	0.2 2
18	0.1 2	0.1 3	0.1 3	0.1 4	0.1 4	0.1 4	0.1 5	0.1 5	0.1 5	0.1 5	0.1 5	0.1 5	0.1 5	0.1 5	0.1 5	0.1 5	0.1 5	0.1 5
19	0.0 6	0.0 6	0.0 7	0.0 7	0.0 7	0.0 7	0.0 7	0.0 8	0.0 8	0.0 8	0.0 8	0.0 8	0.0 8	0.0 8	0.0 8	0.0 8	0.0 8	0.0 7
Add to the measured value																		
21	0.0 6	0.0 7	0.0 7	0.0 7	0.0 7	0.0 7	0.0 8	0.0 8	0.0 8	0.0 8	0.0 8	0.0 8	0.0 8	0.0 8	0.0 8	0.0 8	0.0 8	0.0 7
22	0.1 3	0.1 4	0.1 4	0.1 4	0.1 5	0.1 5	0.1 5	0.1 5	0.1 6	0.1 6	0.1 6	0.1 6	0.1 6	0.1 6	0.1 5	0.1 5	0.1 5	0.1 5
23	0.2 0	0.2 1	0.2 1	0.2 2	0.2 2	0.2 3	0.2 3	0.2 3	0.2 3	0.2 4	0.2 4	0.2 4	0.2 4	0.2 4	0.2 3	0.2 3	0.2 3	0.2 2
24	0.2 7	0.2 8	0.2 9	0.2 9	0.3 0	0.3 0	0.3 1	0.3 1	0.3 1	0.3 2	0.3 2	0.3 2	0.3 2	0.3 2	0.3 1	0.3 1	0.3 1	0.3 0
25	0.3 4	0.3 5	0.3 6	0.3 7	0.3 8	0.3 8	0.3 9	0.3 9	0.4 0	0.4 0	0.4 0	0.4 0	0.4 0	0.4 0	0.3 9	0.3 9	0.3 8	0.3 7
26	0.4 2	0.4 3	0.4 4	0.4 5	0.4 6	0.4 6	0.4 7	0.4 7	0.4 8	0.4 8	0.4 8	0.4 8	0.4 8	0.4 8	0.4 7	0.4 7	0.4 6	0.4 5

Temperature (°)	Measured Sucrose (% solids)																	
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
27	0.5 0	0.5 1	0.5 2	0.5 3	0.5 4	0.5 5	0.5 5	0.5 6	0.5 6	0.5 6	0.5 6	0.5 6	0.5 6	0.5 5	0.5 5	0.5 4	0.5 3	0.5 2
28	0.5 8	0.5 9	0.6 0	0.6 1	0.6 2	0.6 3	0.6 4	0.6 4	0.6 4	0.6 5	0.6 5	0.6 4	0.6 4	0.6 3	0.6 3	0.6 2	0.6 1	0.6 0
29	0.6 6	0.6 7	0.6 8	0.7 0	0.7 1	0.7 1	0.7 2	0.7 3	0.7 3	0.7 3	0.7 3	0.7 3	0.7 2	0.7 2	0.7 1	0.7 0	0.6 9	0.6 7
30	0.7 4	0.7 6	0.7 7	0.7 8	0.7 9	0.8 0	0.8 1	0.8 1	0.8 2	0.8 2	0.8 1	0.8 1	0.8 0	0.8 0	0.7 9	0.7 8	0.7 6	0.7 5
31	0.8 3	0.8 4	0.8 5	0.8 7	0.8 8	0.8 9	0.8 9	0.9 0	0.9 0	0.9 0	0.9 0	0.8 9	0.8 9	0.8 8	0.8 7	0.8 6	0.8 4	0.8 2
32	0.9 2	0.9 3	0.9 4	0.9 6	0.9 7	0.9 8	0.9 8	0.9 9	0.9 9	0.9 9	0.9 9	0.9 8	0.9 7	0.9 6	0.9 5	0.9 3	0.9 2	0.9 0
33	1.0 1	1.0 2	1.0 3	1.0 5	1.0 6	1.0 7	1.0 7	1.0 8	1.0 8	1.0 8	1.0 7	1.0 7	1.0 6	1.0 4	1.0 3	1.0 1	1.0 0	0.9 8
34	1.1 0	1.1 1	1.1 3	1.1 4	1.1 5	1.1 6	1.1 6	1.1 7	1.1 7	1.1 6	1.1 6	1.1 5	1.1 4	1.1 3	1.1 1	1.0 9	1.0 7	1.0 5
35	1.1 9	1.2 1	1.2 2	1.2 3	1.2 4	1.2 5	1.2 5	1.2 6	1.2 6	1.2 5	1.2 5	1.2 4	1.2 3	1.2 1	1.1 9	1.1 7	1.1 5	1.1 3
36	1.2 9	1.3 0	1.3 1	1.3 3	1.3 4	1.3 4	1.3 5	1.3 5	1.3 5	1.3 4	1.3 4	1.3 3	1.3 1	1.2 9	1.2 8	1.2 5	1.2 3	1.2 0
37	1.3 9	1.4 0	1.4 1	1.4 2	1.4 3	1.4 4	1.4 4	1.4 4	1.4 4	1.4 3	1.4 3	1.4 1	1.4 0	1.3 8	1.3 6	1.3 3	1.3 1	1.2 8
38	1.4 9	1.5 0	1.5 1	1.5 2	1.5 3	1.5 3	1.5 4	1.5 4	1.5 3	1.5 3	1.5 2	1.5 0	1.4 8	1.4 6	1.4 4	1.4 2	1.3 9	1.3 6
39	1.5 9	1.6 0	1.6 1	1.6 2	1.6 3	1.6 3	1.6 3	1.6 3	1.6 3	1.6 2	1.6 1	1.5 9	1.5 7	1.5 5	1.5 2	1.5 0	1.4 7	1.4 3
40	1.6 9	1.7 0	1.7 1	1.7 2	1.7 3	1.7 3	1.7 3	1.7 3	1.7 2	1.7 1	1.7 0	1.6 8	1.6 6	1.6 3	1.6 1	1.5 8	1.5 4	1.5 1

^a SOURCE: Adapted from "Refractometry and Tables—Official" (ICUMSA SPS-3 1994), International Commission for Uniform Methods of Sugar Analysis (ICUMSA), c/o British Sugar Technical Centre, Colney, Norwich NR4 7UB, England.

Acceptance criteria

Total Invert Sugar: 71.7%–77.3%

Medium Invert Sugar: 76.2%–77.2%

ADDITIONAL REQUIREMENTS

- **LABELING:** Label to indicate the percentage of total solids and Invert Sugar.
- **PACKAGING AND STORAGE:** Preserve in tight, light-resistant containers.
- **USP REFERENCE STANDARDS (11).**
[USP Dextrose RS](#)
[USP Fructose RS](#)

Auxiliary Information - Please [check for your question in the FAQs](#) before contacting USP.

Topic/Question	Contact	Expert Committee
INVERT SUGAR	Documentary Standards Support	SE2020 Simple Excipients

Chromatographic Database Information: [Chromatographic Database](#)

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