

Supporting Information
for
**Effect of DBU (1,8-diazobicyclo[5.4.0]undec-7-ene) Based
Protic Ionic Liquid on the Volumetric and Ultrasonic Properties of
Ascorbic Acid in Aqueous Solution**

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Table S1. The densities, ρ , apparent molar volumes, $V_{2,\phi}$, speeds of sound, u and apparent molar isentropic compressibilities, $K_{s,2,\phi}$ of ascorbic acid (AA) in water and in aqueous [DBU][TFA] solutions at temperatures, $T = (293.15 \text{ to } 328.15) \text{ K}$ and at **atmospheric** pressure.

T/K	${}^a m_B$ mol kg^{-1}	${}^b m$ mol kg^{-1}	$\rho \cdot 10^{-3}$ kg m^{-3}	$V_{2,\phi} \cdot 10^6$ $\text{m}^3 \cdot \text{mol}^{-1}$	u m s^{-1}	$10^{15} \cdot K_{s,2,\phi}$ $\text{m}^3 \cdot \text{mol}^{-1} \cdot \text{Pa}^{-1}$
Ascorbic acid						
293.15	0.0		(${}^c \rho_o = 0.998206$)		(${}^d u_o = 1482.84$)	
		0.06924	1.003091	105.13	1485.32	-12.16
		0.10269	1.005422	105.16	1486.84	-12.12
		0.15500	1.009032	105.21	1489.23	-12.06
		0.19851	1.012001	105.25	1491.23	-12.00
		0.25161	1.015588	105.28	1493.69	-11.95
		0.27597	1.017216	105.31	1494.82	-11.91
	0.33464	1.021103	105.36	1497.56	-11.83	
298.15			(${}^c \rho_o = 0.997049$)		(${}^d u_o = 1496.85$)	
		0.06924	1.001890	105.81	1499.06	-8.59
		0.10269	1.004200	105.84	1500.43	-8.54
		0.15500	1.007777	105.89	1502.58	-8.45
		0.19851	1.010721	105.92	1504.39	-8.43

	0.25161	1.014275	105.95	1506.60	-8.36
	0.27597	1.015888	105.98	1507.61	-8.30
	0.33464	1.019740	106.03	1510.07	-8.21
303.15		($\rho_o=0.995660$)		($u_o=1509.25$)	
	0.06924	1.000470	106.31	1511.65	-5.50
	0.10269	1.002766	106.34	1512.88	-5.47
	0.15500	1.006321	106.38	1514.82	-5.43
	0.19851	1.009246	106.41	1516.44	-5.37
	0.25161	1.012775	106.45	1518.43	-5.31
	0.27597	1.014375	106.49	1519.35	-5.27
	0.33464	1.018204	106.53	1521.56	-5.18
308.15		($\rho_o=0.994045$)		($u_o=1519.82$)	
	0.06924	0.998811	107.01	1521.41	-4.01
	0.10269	1.001083	107.07	1522.59	-3.95
	0.15500	1.004602	107.12	1524.45	-3.89
	0.19851	1.007488	107.20	1526.02	-3.84
	0.25161	1.010983	107.23	1527.94	-3.80
	0.27597	1.012565	107.27	1528.82	-3.75
	0.33464	1.016344	107.34	1530.96	-3.67
313.15		($\rho_o=0.992228$)		($u_o=1528.89$)	
	0.06924	0.996961	107.57	1531.16	0.01
	0.10269	0.999216	107.63	1532.14	0.03
	0.15500	1.002713	107.66	1533.67	0.09
	0.19851	1.005588	107.70	1534.95	0.15
	0.25161	1.009056	107.75	1536.53	0.21
	0.27597	1.010625	107.80	1537.27	0.24
	0.33464	1.014388	107.84	1539.04	0.29
318.15		($\rho_o=0.990223$)		($u_o=1536.56$)	
	0.06924	0.994936	107.94	1537.95	1.13
	0.10269	0.997180	108.02	1538.87	1.19
	0.15500	1.000658	108.07	1540.32	1.24
	0.19851	1.003515	108.13	1541.54	1.29
	0.25161	1.006965	108.18	1543.03	1.36
	0.27597	1.008523	108.24	1543.72	1.42
	0.33464	1.012253	108.32	1545.39	1.51
323.15		($\rho_o=0.9888030$)		($u_o=1542.73$)	
	0.06924	0.992708	108.54	1544.94	2.56
	0.10269	0.994939	108.59	1545.79	2.63
	0.15500	0.998391	108.65	1547.14	2.67
	0.19851	1.001229	108.70	1548.27	2.73
	0.25161	1.004643	108.80	1549.67	2.80
	0.27597	1.006197	108.83	1550.32	2.82
	0.33464	1.009899	108.91	1551.88	2.91
328.15		($\rho_o=0.985690$)		($u_o=1547.61$)	
	0.06924	0.990343	109.00	1548.43	4.07
	0.10269	0.992562	109.05	1549.21	4.09

		0.15500	0.995996	109.11	1550.44	4.14
		0.19851	0.998819	109.16	1551.46	4.22
		0.25161	1.002229	109.20	1552.73	4.26
		0.27597	1.003773	109.24	1553.32	4.29
		0.33464	1.007462	109.31	1554.72	4.40
293.15	0.10		($\rho_o=1.004155$)		($u_o=1496.50$)	
		0.07846	1.009608	105.90	1499.29	-8.78
		0.10366	1.011349	105.82	1500.35	-8.74
		0.20701	1.018412	105.60	1504.72	-8.68
		0.31591	1.025738	105.38	1509.33	-8.64
		0.34234	1.027511	105.29	1510.42	-8.62
		0.48803	1.037113	104.98	1516.55	-8.56
298.15			($\rho_o=1.002937$)		($u_o=1509.24$)	
		0.07846	1.008335	106.64	1511.72	-5.03
		0.10366	1.010055	106.59	1512.66	-5.00
		0.20701	1.017044	106.37	1516.51	-4.94
		0.31591	1.024292	106.15	1520.56	-4.89
		0.34234	1.026040	106.08	1521.52	-4.86
		0.48803	1.035531	105.78	1526.87	-4.76
303.15			($\rho_o=1.001476$)		($u_o=1520.43$)	
		0.07846	1.006837	107.17	1522.91	-1.89
		0.10366	1.008554	107.03	1523.72	-1.86
		0.20701	1.015504	106.81	1527.07	-1.78
		0.31591	1.022733	106.52	1530.55	-1.72
		0.34234	1.024499	106.37	1531.35	-1.70
		0.48803	1.034005	105.97	1535.89	-1.62
308.15			($\rho_o=0.999799$)		($u_o=1530.04$)	
		0.07846	1.005108	107.90	1532.92	-0.24
		0.10366	1.006803	107.82	1533.69	-0.21
		0.20701	1.013705	107.47	1536.82	-0.15
		0.31591	1.020892	107.11	1540.05	-0.09
		0.34234	1.022642	106.97	1540.79	-0.06
		0.48803	1.032096	106.52	1544.97	0.03
313.15			($\rho_o=0.997921$)		($u_o=1538.15$)	
		0.07846	1.003188	108.51	1539.24	3.91
		0.10366	1.004872	108.41	1539.83	3.97
		0.20701	1.011723	108.05	1542.24	4.05
		0.31591	1.018878	107.62	1544.67	4.13
		0.34234	1.020607	107.51	1545.23	4.16
		0.48803	1.030033	106.98	1548.29	4.29
318.15			($\rho_o=0.995860$)		($u_o=1544.78$)	
		0.07846	1.001101	108.93	1546.16	5.11
		0.10366	1.002776	108.83	1546.72	5.10
		0.20701	1.009604	108.42	1548.93	5.19
		0.31591	1.016716	108.03	1551.18	5.28
		0.34234	1.018439	107.91	1551.69	5.31

323.15		0.48803	1.027859	107.30	1554.47	5.40
			($\rho_o=0.993602$)		($u_o=1550.07$)	
		0.07846	0.998789	109.73	1551.45	6.64
		0.10366	1.000444	109.65	1551.96	6.65
		0.20701	1.007168	109.39	1554.02	6.74
		0.31591	1.014166	109.07	1556.13	6.79
		0.34234	1.015852	108.99	1556.62	6.82
328.15		0.48803	1.025034	108.59	1559.33	6.91
			($\rho_o=0.991354$)		($u_o=1554.09$)	
		0.07846	0.996492	110.46	1554.89	8.25
		0.10366	0.998131	110.39	1555.35	8.24
		0.20701	1.004780	110.18	1557.21	8.31
		0.31591	1.011663	110.00	1559.17	8.36
		0.34234	1.013331	109.91	1559.61	8.38
293.15	0.20	0.48803	1.022342	109.63	1562.15	8.45
			($\rho_o=1.009711$)		($u_o=1508.44$)	
		0.08045	1.015265	106.14	1512.21	-6.96
		0.10196	1.016738	106.10	1513.10	-6.96
		0.19313	1.022925	105.94	1516.86	-6.89
		0.27622	1.028497	105.76	1520.27	-6.84
		0.31783	1.031285	105.60	1521.93	-6.80
298.15		0.49528	1.042914	105.22	1529.13	-6.69
			($\rho_o=1.008411$)		($u_o=1520.03$)	
		0.08045	1.013908	106.89	1523.30	-3.37
		0.10196	1.015370	106.81	1524.07	-3.34
		0.19313	1.021502	106.62	1527.34	-3.26
		0.27622	1.027038	106.38	1530.28	-3.20
		0.31783	1.029790	106.26	1531.74	-3.18
303.15		0.49528	1.041312	105.88	1537.96	-3.06
			($\rho_o=1.006876$)		($u_o=1530.13$)	
		0.08045	1.012330	107.47	1533.01	-0.16
		0.10196	1.013777	107.43	1533.68	-0.14
		0.19313	1.019870	107.18	1536.50	-0.09
		0.27622	1.025343	107.02	1539.07	-0.05
		0.31783	1.028083	106.86	1540.30	-0.004
308.15		0.49528	1.039516	106.47	1545.64	0.11
			($\rho_o=1.005128$)		($u_o=1538.69$)	
		0.08045	1.010522	108.28	1541.48	1.38
		0.10196	1.011953	108.24	1542.11	1.42
		0.19313	1.017967	108.05	1544.78	1.49
		0.27622	1.023388	107.84	1547.17	1.56
		0.31783	1.026072	107.76	1548.37	1.58
313.15		0.49528	1.037371	107.35	1553.38	1.69
			($\rho_o=1.003183$)		($u_o=1545.82$)	
		0.08045	1.008527	108.99	1547.95	5.54
		0.10196	1.009949	108.90	1548.43	5.56

		0.19313	1.015910	108.71	1550.47	5.63
		0.27622	1.021283	108.50	1552.28	5.70
		0.31783	1.023954	108.39	1553.17	5.74
		0.49528	1.035162	107.97	1556.92	5.85
318.15			$(^c\rho_o=1.001051)$		$(^d u_o=1551.56)$	
		0.08045	1.006363	109.47	1553.18	6.72
		0.10196	1.007773	109.42	1553.62	6.77
		0.19313	1.013686	109.28	1555.51	6.85
		0.27622	1.018993	109.17	1557.22	6.92
		0.31783	1.021639	109.06	1558.05	6.94
		0.49528	1.032671	108.80	1561.62	7.08
323.15			$(^c\rho_o=0.998711)$		$(^d u_o=1556.01)$	
		0.08045	1.003981	110.10	1556.69	8.25
		0.10196	1.005381	110.04	1557.08	8.31
		0.19313	1.011249	109.89	1558.78	8.32
		0.27622	1.016523	109.75	1560.29	8.40
		0.31783	1.019150	109.64	1561.02	8.44
		0.49528	1.030124	109.33	1564.18	8.54
328.15			$(^c\rho_o=0.995897)$		$(^d u_o=1559.25)$	
		0.08045	1.001122	110.79	1560.58	9.85
		0.10196	1.002508	110.75	1560.93	9.86
		0.19313	1.008314	110.65	1562.43	9.91
		0.27622	1.013523	110.56	1563.79	9.96
		0.31783	1.016113	110.48	1564.45	9.99
		0.49528	1.026918	110.27	1567.29	10.12
293.15	0.30		$(^c\rho_o=1.015268)$		$(^d u_o=1520.37)$	
		0.08126	1.021004	104.41	1524.17	-9.25
		0.14058	1.025175	104.10	1526.76	-9.22
		0.21456	1.030327	103.85	1529.98	-9.17
		0.25020	1.032797	103.72	1531.51	-9.13
		0.35902	1.040338	103.19	1536.07	-9.04
		0.40706	1.043625	103.02	1538.08	-8.99
298.15			$(^c\rho_o=1.013886)$		$(^d u_o=1530.82)$	
		0.08126	1.019558	105.23	1533.79	-5.61
		0.14058	1.023660	105.07	1536.09	-5.54
		0.21456	1.028735	104.86	1538.93	-5.46
		0.25020	1.031170	104.73	1540.28	-5.43
		0.35902	1.038535	104.39	1544.37	-5.34
		0.40706	1.041743	104.28	1546.17	-5.29
303.15			$(^c\rho_o=1.012275)$		$(^d u_o=1539.83)$	
		0.08126	1.017908	105.76	1541.92	-2.41
		0.14058	1.021989	105.55	1543.90	-2.33
		0.21456	1.027034	105.33	1546.36	-2.29
		0.25020	1.029452	105.21	1547.52	-2.25
		0.35902	1.036775	104.86	1551.01	-2.13
		0.40706	1.039991	104.68	1552.52	-2.09

308.15		$(^c\rho_o=1.010458)$		$(^d u_o=1547.35)$		
		0.08126	1.016039	106.45	1550.58	-0.80
		0.14058	1.020087	106.21	1552.43	-0.72
		0.21456	1.025084	106.01	1554.74	-0.69
		0.25020	1.027490	105.85	1555.81	-0.64
		0.35902	1.034798	105.37	1559.00	-0.54
313.15		$(^c\rho_o=1.008444)$		$(^d u_o=1553.49)$		
		0.08126	1.013965	107.26	1555.34	3.29
		0.14058	1.017956	107.11	1556.81	3.36
		0.21456	1.022885	106.94	1558.63	3.41
		0.25020	1.025259	106.79	1559.46	3.47
		0.35902	1.032404	106.50	1562.02	3.58
318.15		$(^c\rho_o=1.006243)$		$(^d u_o=1558.34)$		
		0.08126	1.011742	107.61	1560.66	4.55
		0.14058	1.015726	107.40	1562.00	4.58
		0.21456	1.020651	107.18	1563.64	4.63
		0.25020	1.023027	107.00	1564.39	4.66
		0.35902	1.030184	106.64	1566.67	4.76
323.15		$(^c\rho_o=1.003821)$		$(^d u_o=1561.95)$		
		0.08126	1.009261	108.44	1564.30	6.00
		0.14058	1.013190	108.31	1565.53	6.09
		0.21456	1.018036	108.18	1567.07	6.13
		0.25020	1.020352	108.11	1567.79	6.18
		0.35902	1.027368	107.84	1569.96	6.26
328.15		$(^c\rho_o=1.000440)$		$(^d u_o=1564.91)$		
		0.08126	1.005830	109.19	1566.74	7.63
		0.14058	1.009721	109.08	1567.85	7.63
		0.21456	1.014517	108.97	1569.21	7.72
		0.25020	1.016805	108.92	1569.87	7.74
		0.35902	1.023722	108.73	1571.82	7.85
293.15	0.40	$(^c\rho_o=1.020824)$		$(^d u_o=1532.30)$		
		0.08073	1.026503	104.45	1536.47	-9.57
		0.11530	1.028921	104.32	1538.07	-9.53
		0.21843	1.036057	104.06	1542.84	-9.45
		0.27938	1.040235	103.89	1545.64	-9.41
		0.37296	1.046604	103.59	1549.89	-9.34
298.15		$(^c\rho_o=1.019360)$		$(^d u_o=1541.61)$		
		0.43933	1.051069	103.41	1552.89	-9.29
		0.08073	1.024981	105.20	1544.51	-5.82
		0.11530	1.027367	105.13	1545.91	-5.75
		0.21843	1.034409	104.93	1550.11	-5.70

	0.27938	1.038527	104.79	1552.56	-5.64
	0.37296	1.044793	104.55	1556.30	-5.59
	0.43933	1.049188	104.39	1558.93	-5.53
303.15		($\rho_o=1.017675$)		($u_o=1549.52$)	
	0.08073	1.023258	105.72	1552.87	-2.56
	0.11530	1.025625	105.67	1554.09	-2.51
	0.21843	1.032626	105.43	1557.70	-2.43
	0.27938	1.036717	105.29	1559.82	-2.39
	0.37296	1.042953	105.02	1562.99	-2.29
	0.43933	1.047330	104.84	1565.23	-2.25
		($\rho_o=1.015786$)		($u_o=1556.00$)	
308.15	0.08073	1.021314	106.45	1557.94	-0.92
	0.11530	1.023665	106.34	1559.07	-0.86
	0.21843	1.030601	106.11	1562.44	-0.78
	0.27938	1.034660	105.95	1564.40	-0.73
	0.37296	1.040856	105.64	1567.32	-0.64
	0.43933	1.045196	105.46	1569.38	-0.58
		($\rho_o=1.013706$)		($u_o=1561.15$)	
313.15	0.08073	1.019187	107.10	1562.80	3.13
	0.11530	1.021519	106.98	1563.68	3.19
	0.21843	1.028395	106.76	1566.31	3.27
	0.27938	1.032410	106.63	1567.85	3.31
	0.37296	1.038561	106.29	1570.09	3.40
	0.43933	1.042864	106.11	1571.69	3.43
		($\rho_o=1.011434$)		($u_o=1565.12$)	
318.15	0.08073	1.016880	107.62	1566.33	4.35
	0.11530	1.019193	107.53	1567.16	4.37
	0.21843	1.026019	107.32	1569.61	4.45
	0.27938	1.029986	107.26	1571.07	4.50
	0.37296	1.036037	107.05	1573.20	4.62
	0.43933	1.040270	106.93	1574.73	4.66
		($\rho_o=1.008931$)		($u_o=1567.89$)	
323.15	0.08073	1.014343	108.13	1570.01	5.86
	0.11530	1.016642	108.05	1570.75	5.89
	0.21843	1.023470	107.63	1572.87	5.97
	0.27938	1.027447	107.49	1574.13	6.00
	0.37296	1.033517	107.20	1575.98	6.06
	0.43933	1.037772	107.02	1577.28	6.10
		($\rho_o=1.004983$)		($u_o=1572.56$)	
328.15	0.08073	1.010364	108.68	1574.81	7.45
	0.11530	1.012655	108.55	1575.44	7.49
	0.21843	1.019416	108.28	1577.31	7.57
	0.27938	1.023388	108.05	1578.35	7.62
	0.37296	1.029399	107.82	1579.94	7.72
	0.43933	1.033651	107.58	1580.98	7.79

^a m_B is the molality of [DBU][TFA] in water, ^b m is the molality of ascorbic acid in water or water + [DBU][TFA] solutions, ^c ρ_o is the density of [DBU][TFA] in water, ^d u_o is the speed of sound of [DBU][TFA] in water. The standard uncertainties are $u(T) = 0.01$ K, $u(m) = 1.39 \cdot 10^{-5}$ mol·kg⁻¹, $u(\rho) = 7.0 \cdot 10^{-3}$ kg·m⁻³, $u(u) = 0.5$ m·s⁻¹, $u(P) = 0.05$ kPa. The combined uncertainties, U are $U(V_\phi) = (0.18$ to $0.02) \cdot 10^6$ m³·mol⁻¹ and $U(K_{s2,\phi}) = (0.98$ to $0.40) \cdot 10^{-15}$ m³·mol⁻¹·Pa⁻¹ for low and high concentration range of ascorbic acid, respectively (level of confidence, $k = 0.95$). The experiment was conducted under atmospheric pressure. The water content present in [DBU][TFA] has been taken into account for the molality correction of stock solutions ([DBU][TFA] + water).

Table S2. The pair, V_{AB} and triplet, V_{ABB} interaction coefficients for AA in aqueous [DBU][TFA] solutions at $T = (293.15$ to $328.15)$ K.

$V_{AB} \cdot 10^6$ m ³ ·mol ⁻² ·kg	$V_{ABB} \cdot 10^6$ cm ³ ·mol ⁻² ·kg ²	$V_{AB} \cdot 10^6$ m ³ ·mol ⁻² ·kg	$V_{ABB} \cdot 10^6$ m ³ ·mol ⁻² ·kg ²
	$T = 293.15$ K	$T = 298.15$ K	
5.34	-10.38	5.57	-10.68
	$T = 303.15$ K	$T = 308.15$ K	
5.97	-11.24	6.51	-12.09
	$T = 313.15$ K	$T = 318.15$ K	
6.99	-12.72	7.38	-13.23
	$T = 323.15$ K	$T = 328.15$ K	
7.89	-13.97	8.85	-15.47

Table S3. The pair, K_{AB} and triplet, K_{ABB} compressibility interaction coefficients for AA in aqueous [DBU][TFA] solutions at temperatures, $T = (293.15$ to $328.15)$ K.

K_{AB} m ³ ·mol ⁻² ·Pa ⁻¹ ·kg	K_{ABB} m ³ ·mol ⁻³ ·Pa ⁻¹ ·kg ²	K_{AB} m ³ ·mol ⁻² ·Pa ⁻¹ ·kg	K_{ABB} m ³ ·mol ⁻³ ·Pa ⁻¹ ·kg ²
	$T = 293.15$ K	$T = 298.15$ K	
19.97	-28.88	20.22	-28.96
	$T = 303.15$ K	$T = 308.15$ K	
20.56	-29.21	20.85	-29.47
	$T = 313.15$ K	$T = 318.15$ K	
21.48	-30.44	21.96	-31.05
	$T = 323.15$ K	$T = 328.15$ K	
22.24	-31.39	22.74	-32.09