

Brew temperature, at fixed brew strength and extraction, has little impact on the sensory profile of drip brew coffee

Batali, Mackenzie E.¹, Ristenpart, William D.^{2*}, Guinard, Jean-Xavier¹

Author affiliations

¹Department of Food Science and Technology
University of California, Davis
One Shields Avenue
Davis, CA, 95616 USA

²Department of Chemical Engineering
University of California, Davis
One Shields Avenue
Davis, CA, 95616 USA

***Corresponding author**

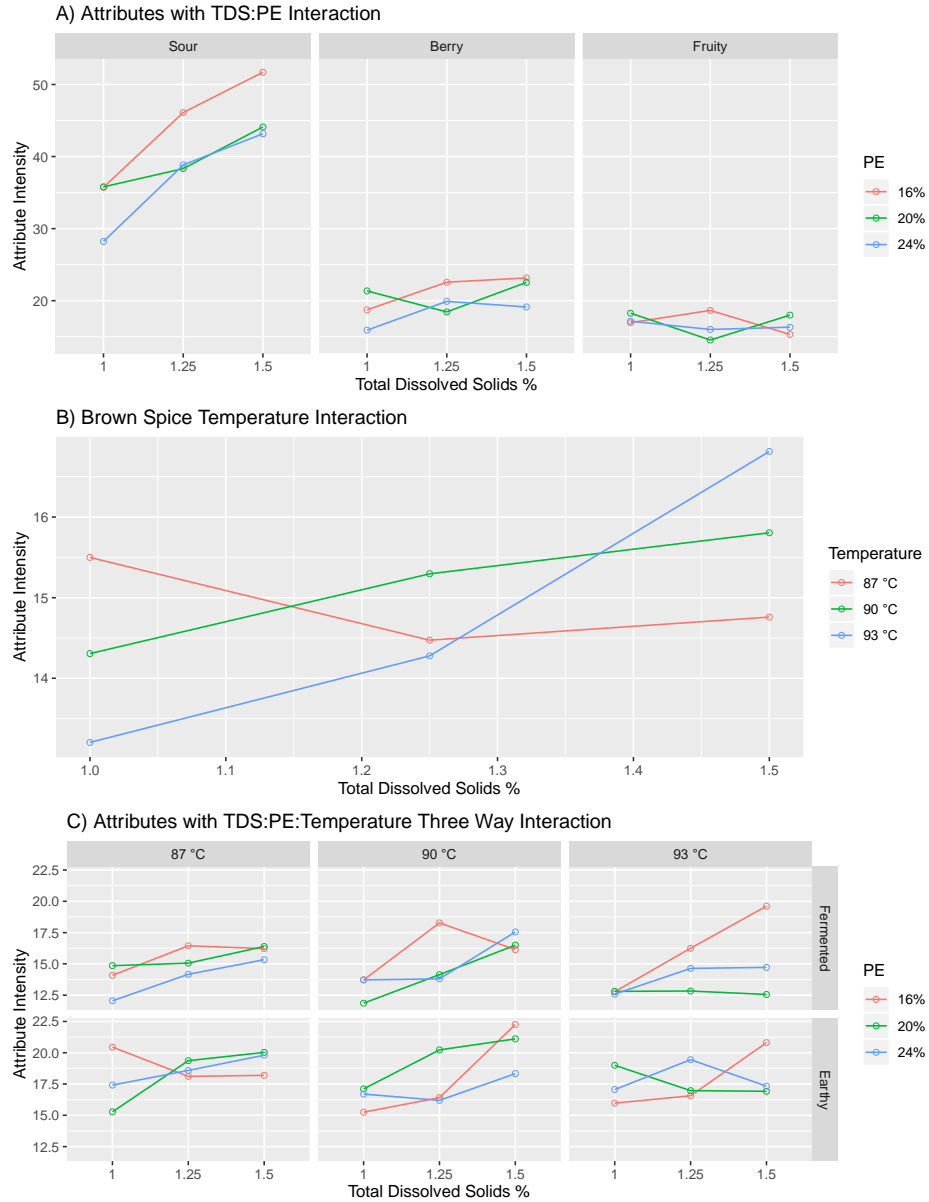
wdristenpart@ucdavis.edu

Supplementary Figures:

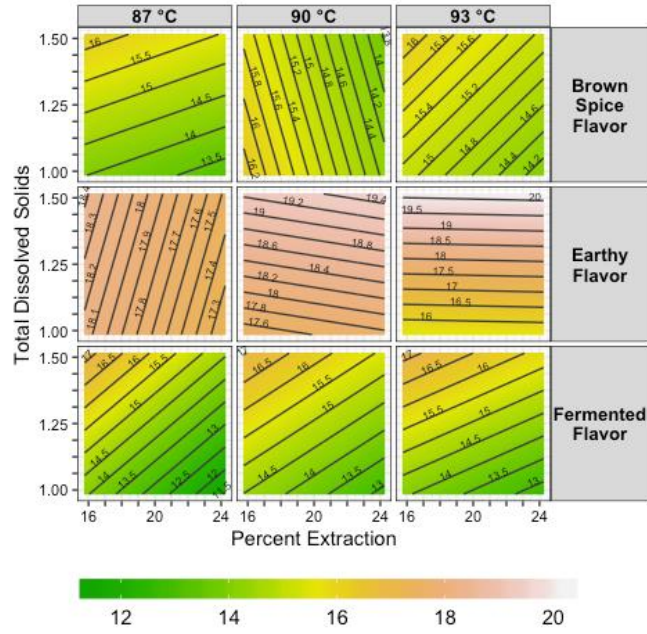
- S1.** Interaction plots of attributes with significant two-way or three-way interactions.
- S2.** Response surface contour plots of attributes with higher order interactions.
- S3.** Roasting temperature curves.

Supplementary Tables:

- S1.** Brewing parameters for all samples, with measured temperature, TDS, and PE values.
- S2.** Table of F-ratios from multivariate analysis of variance.
- S3.** F-ratios for univariate analysis of variance.
- S4.** F-ratios for pseudomixed analysis of variance for Judge/TDS effect and Judge/PE effect.
- S5.** Mean intensities for all measured sensory attributes.

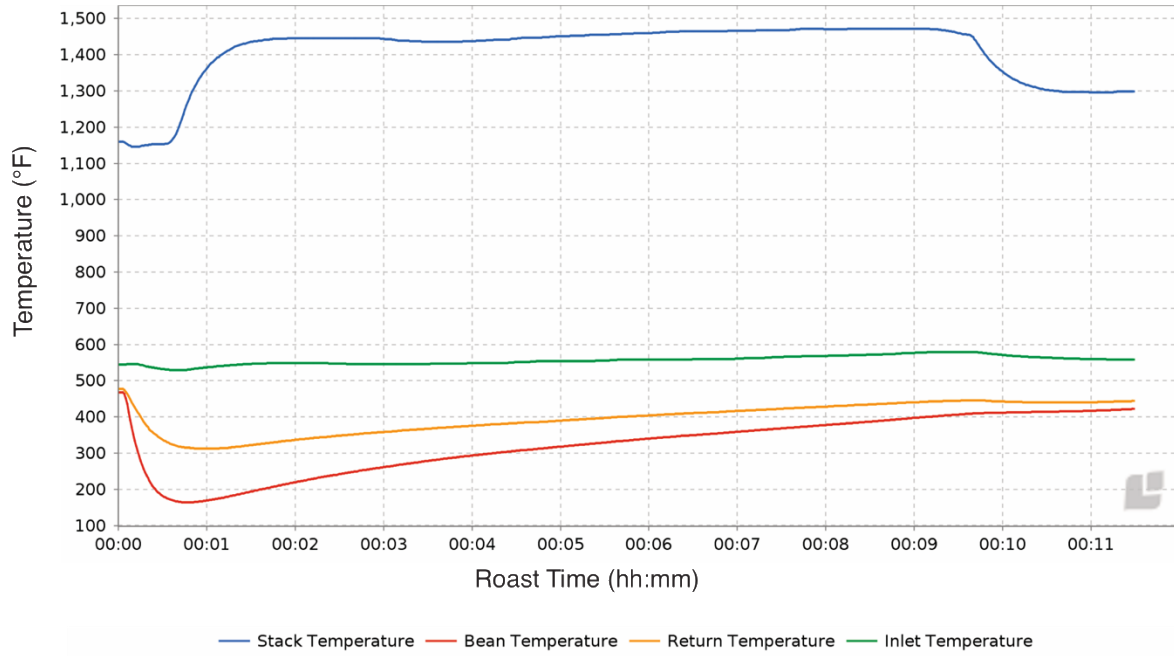


Supplementary Figure S1. Interaction plots of attributes with significant two-way (a, b) or three-way (c) interactions.



Supplementary Figure S2. Response surface methodology contour plots of attributes with Temperature x TDS or Temperature x TDS x PE interactions, to visualize how the interaction effects change the slope of the fit.

Roast Area Index	222,649.6 °F	End Temperature	421.7 °F
Development time	149 s	Development time ratio	21.6 %
Charge Temperature	468.1 °F		



Supplementary Figure S3. Roasting temperature curves, as provided by Royal Coffee.

Target TDS (%)	Target PE (%)	Brew Temp (°C)	Ground coffee mass (g)	Brew Ratio	Grind Size	Brew Duration (m:ss)	Water on (m:ss)	Water off (m:ss)	Water on/off cycles	Temp post-brew (°C)	Mean TDS (%)	Mean PE (%)
1.00	16	87	176.1	17.5	5	7:00	1:20	:40	2	80.4	1.05 ± 0.03	16.9 ± 0.58
1.00	16	90	176.1	17.5	5	6:44	:40	:16	4	82.5	1.04 ± 0.02	17.0 ± 0.38
1.00	16	93	176.1	17.5	5	6:20	1:20	:20	2	85.4	1.00 ± 0.02	16.0 ± 0.23
1.00	20	87	145.0	21.2	3	6:44	:40	:16	4	80.6	1.00 ± 0.02	19.7 ± 1.22
1.00	20	90	145.0	21.2	3	6:44	:40	:16	4	82.2	1.03 ± 0.02	20.1 ± 1.28
1.00	20	93	140.3	21.9	3	6:12	1:20	:16	2	85.0	1.02 ± 0.03	19.9 ± 1.99
1.00	24	87	119.0	25.8	3	11:00	:40	1:30	4	78.4	0.99 ± 0.06	24.4 ± 1.66
1.00	24	90	121.1	25.4	3	9:00	:16	:20	10	81.4	0.95 ± 0.03	22.4 ± 0.95
1.00	24	93	120.0	25.6	3	11:00	:40	1:30	4	82.3	1.08 ± 0.20	24.1 ± 5.34
1.25	16	87	215.3	14.3	5	7:48	:20	:16	8	79.8	1.34 ± 0.03	17.6 ± 0.31
1.25	16	90	215.3	14.3	5	7:00	:40	:20	4	82.0	1.28 ± 0.11	18.0 ± 2.05
1.25	16	93	215.3	14.3	5	7:00	:40	:20	4	84.8	1.34 ± 0.03	17.4 ± 0.45
1.25	20	87	176.1	17.5	3	7:48	:20	:16	8	80.8	1.28 ± 0.02	20.5 ± 0.56
1.25	20	90	176.1	17.5	3	7:48	:20	:16	8	81.7	1.29 ± 0.04	20.5 ± 1.60
1.25	20	93	176.1	17.5	3	7:00	1:20	:40	2	84.6	1.33 ± 0.02	21.1 ± 0.28
1.25	24	87	150.0	20.5	4	9:00	:16	:20	10	77.5	1.28 ± 0.25	24.5 ± 4.74
1.25	24	90	149.0	20.6	3	11:00	:40	1:30	4	80.1	1.24 ± 0.11	23.4 ± 2.19
1.25	24	93	150.0	20.5	3	9:00	:16	:20	10	83.6	1.23 ± 0.04	23.1 ± 0.76
1.50	16	87	252.7	12.2	5	7:28	:40	:27	4	79.4	1.53 ± 0.03	16.9 ± 0.31
1.50	16	90	252.7	12.2	5	7:28	:40	:27	4	80.9	1.51 ± 0.12	17.8 ± 2.07
1.50	16	93	265.0	11.7	5	6:44	:40	:16	4	83.9	1.60 ± 0.11	17.8 ± 2.60
1.50	20	87	207.6	14.8	3	7:28	:40	:27	4	80.2	1.45 ± 0.03	19.7 ± 0.25
1.50	20	90	207.6	14.8	3	7:28	:40	:27	4	82.0	1.51 ± 0.05	20.1 ± 0.71
1.50	20	93	207.6	14.8	4	8:20	:40	:40	4	83.4	1.51 ± 0.06	19.4 ± 1.36
1.50	24	87	176.1	17.5	3	11:00	:40	1:30	4	78.4	1.45 ± 0.06	23.2 ± 1.04
1.50	24	90	176.1	17.5	3	11:00	:40	1:30	4	80.3	1.52 ± 0.16	24.5 ± 2.62
1.50	24	93	176.1	17.5	3	11:00	:40	1:30	4	82.8	1.50 ± 0.06	23.8 ± 0.95

Supplementary Table S1. All brewing parameters for all samples, each sample represented by a unique combination of TDS, PE, and brewing temperature, with average measured TDS and PE and standard deviation. All brews included a 3-minute drip out period at the end of the brew. Grind size refers to setting on a Mahlkönig Guatemala Grinder, with 3 at $770 \pm 10 \mu\text{m}$, 4 at $928 \pm 3 \mu\text{m}$, and 5 at $1115 \pm 74 \mu\text{m}$ (reference 15 from main manuscript).

Factor	df	F-ratio	P-value
<i>Temperature</i>	2	1.25	0.11
<i>TDS</i>	2	5.44	<0.001***
<i>PE</i>	2	2.46	<0.001***
<i>Judge</i>	11	52.69	<0.001***
<i>Rep</i>	2	4.75	<0.001***
<i>Judge:Rep</i>	22	3.01	<0.001***
<i>Judge:Temperature</i>	22	0.96	0.72
<i>Judge:TDS</i>	22	1.98	<0.001***
<i>Judge:PE</i>	22	1.31	<0.001***
<i>Rep:Temperature</i>	4	0.83	0.90
<i>Rep:TDS</i>	4	0.83	0.89
<i>Rep:PE</i>	4	1.12	0.19
<i>Temperature:TDS</i>	4	1.16	0.14
<i>Temperature:PE</i>	4	1.07	0.30
<i>TDS:PE</i>	4	1.56	<0.001***
<i>Judge:Rep:Temperature</i>	44	0.98	0.67
<i>Judge:Rep:TDS</i>	44	1.16	<0.001***
<i>Judge:Rep:PE</i>	44	1.1	0.015*
<i>Judge:Temperature:TDS</i>	44	1.08	0.035*
<i>Judge:Temperature:PE</i>	44	1.02	0.28
<i>Judge:TDS:PE</i>	44	1.10	0.0071**
<i>Rep:Temperature:TDS</i>	8	1.09	0.18
<i>Rep:Temperature:PE</i>	8	1.04	0.32
<i>Rep:TDS:PE</i>	8	1.15	0.068
<i>Temperature:TDS:PE</i>	8	1.10	0.17
<i>Judge:Rep:Temperature:TDS</i>	88	1.09	<0.001***
<i>Judge:Rep:Temperature:PE</i>	88	1.07	0.027*
<i>Judge:Rep:TDS:PE</i>	88	1.02	0.041*
<i>Judge:Temperature:TDS:PE</i>	88	1.10	0.0022**
<i>Rep:Temperature:TDS:PE</i>	16	1.02	0.38

Supplementary Table S2. Table of F-ratios from Multivariate Analysis of Variance, significance indicated by * ($\alpha = 0.05$), with corresponding degrees of freedom (df) and p-values.

Factor	df	Nutty Aroma	Floral Aroma	Green Aroma	Bitter Taste	Sour Taste	Sweet Taste	Salty Taste	Astringent Mouthfeel	Viscous Mouthfeel	Black Tea Flavor	Berry Flavor	Dried Fruit Flavor
Temperature	2	0.34	7.25*	0.57	1.36	0.06	0.75	0.02	1.37	0.61	1.46	2.14	1.05
TDS	2	3.44	1.40	3.11*	49.20*	97.14*	4.71*	0.48	77.56*	28.24*	6.48*	6.64*	4.17*
Percent.Extraction	2	0.051	1.80	0.89	1.53	35.04*	2.39	0.82	5.74*	2.41	9.80*	8.40*	0.16
Rep	2	0.61	5.12*	1.22	8.03*	0.44	2.90	1.63	0.22	0.65	1.98	2.48	17.81*
Participant.Name	11	122.65*	98.42*	87.64*	126.4*	129.05*	124.28*	188.39*	138.77*	66.65*	98.37*	27.91*	95.33*
Temperature:TDS	4	0.336	0.34	0.98	0.71	2.30	0.96	1.16	0.97	0.60	0.35	1.77	1.45
Temperature:Percent.Extraction	4	1.28	0.06	1.92	0.26	0.96	2.28	1.07	2.23	0.77	0.98	1.19	1.17
Temperature:Rep	4	0.504	0.91	1.05	0.61	0.81	0.71	0.27	1.04	0.16	0.65	0.85	1.14
Temperature:Participant.Name	22	1.07	0.82	1.18	1.58	0.98	0.91	0.68	1.17	1.26	1.62*	0.71	0.68
TDS:Percent.Extraction	4	1.132	1.04	1.15	3.43*	4.87*	1.73	1.90	1.44	0.95	2.38	4.17*	0.40
TDS:Rep	4	0.44	0.98	2.14	2.83*	0.62	0.32	1.05*	1.00	1.52	1.61	0.59	0.95
TDS:Participant.Name	22	1.744*	0.60	1.69*	1.92*	2.78*	2.11*	2.11	5.56*	4.74*	2.30*	1.13	3.67*
Percent.Extraction:Rep	4	3.14*	0.66	0.90	1.00	1.39	2.19*	0.76	0.87	1.60	0.74	0.36	1.64
Percent.Extraction:Participant.Name	22	0.960	2.83*	2.13*	1.39	1.75*	1.53	1.16	2.21*	2.08*	2.32*	0.85	1.61*
Rep:Participant.Name	22	6.45*	6.87*	5.30	2.47*	1.94*	3.76*	3.44*	3.56*	2.20*	2.47*	1.44	3.67*
Temperature:TDS:Percent.Extraction	8	2.26*	0.85	2.25*	1.18	0.74	1.11	1.36	1.00	0.48	0.87	1.05	1.43
Temperature:TDS:Rep	8	1.88	1.86	1.08	0.68	1.31	1.14	1.92	1.07	0.73	0.88	0.61	0.94
Temperature:TDS:Participant.Name	44	1.27	1.49	1.18	1.02	0.70	0.95	2.28*	1.11	1.04	0.77	0.88	0.99
Temperature:Percent.Extraction:Rep	8	1.13	1.16	1.32	0.68	0.84	1.50	0.89	1.26	1.41	0.84	1.85	0.39
Temperature:Percent.Extraction:Participant.Name	44	0.97	0.91	1.07	1.15	1.09	0.96	1.13	0.91	0.69	0.95	1.31	1.22
Temperature:Rep:Participant.Name	44	0.90	0.70	0.99	1.20	0.97	0.79	0.66	1.09	0.85	0.74	1.11	0.99
TDS:Percent.Extraction:Rep	8	0.85	1.00	1.45	1.49	1.03	1.14	1.27	1.42	0.89	0.58	1.18	0.77
TDS:Percent.Extraction:Participant.Name	44	1.26	0.95	1.15	0.93	0.99	0.85	1.32	1.19	0.69	1.49*	1.69*	1.05
TDS:Rep:Participant.Name	44	1.68*	1.44	1.12	1.22	0.83	1.33*	1.37	1.23	1.05	0.93	1.17	1.14
Percent.Extraction:Rep:Participant.Name	44	1.01	1.36	1.02	1.06	1.43*	1.65*	0.68	1.21	0.84	1.18	1.11	1.04
Temperature:TDS:Percent.Extraction:Rep	16	0.73	0.88	1.30	0.98	1.90*	1.11	0.71	0.74	1.47	0.61	1.78	1.32
Temperature:TDS:Percent.Extraction:Participant.Name	88	1.35*	1.11	1.02	1.60*	1.09	0.98	1.19	1.18	1.18	1.36*	1.10	1.26
Temperature:TDS:Rep:Participant.Name	88	1.30	1.84*	1.26	0.95	1.14	0.79	1.17	1.31	0.94	1.04	1.32	1.01
Temperature:Percent.Extraction:Rep:Participant.Name	88	1.05	1.16	1.24	1.27	0.76	1.13	0.91	1.48*	1.01	0.96	0.85	1.02
TDS:Percent.Extraction:Rep:Participant.Name	88	1.21	1.11	1.01	1.22	1.04	1.05	0.87	1.42*	1.14	0.83	1.16	1.04

Supplementary Table S3. F-ratios for univariate analysis of variance, significance indicated by * ($\alpha = 0.05$).

Factor:	df	Fruity Flavor	Citrus Flavor	Fermented Flavor	Fresh Green Flavor	Dark Green Flavor	Woody Flavor	Papery/Musty Flavor	Rubber Flavor	Earthy Flavor	Ashy Flavor
<i>Temperature</i>	2	0.15	0.74	1.20	0.38	0.60	0.21	1.51	0.12	0.82	1.42
<i>TDS</i>	2	1.03	70.30*	15.63*	1.60	19.38*	4.30*	4.24*	16.94*	6.86*	32.71*
<i>Percent.Extraction</i>	2	0.22	30.58*	7.17*	1.02	0.94	1.94	3.23	0.91	0.43	2.05
<i>Rep</i>	2	2.03	0.34	2.25	3.19*	12.34*	1.22	9.88*	0.19	1.50	12.35*
<i>Participant.Name</i>	11	50.21*	112.79*	100.17*	80.39*	116.59*	61.72*	98.94*	98.88*	140.1*4	67.63*
<i>Temperature:TDS</i>	4	0.33	0.38	0.25	1.70	2.15	0.59	1.00	0.86	1.39	1.47
<i>Temperature:Percent.Extraction</i>	4	0.36	0.63	2.14	1.54	1.03	0.76	1.15	0.61	1.18	0.98
<i>Temperature:Rep</i>	4	1.37	0.34	0.34	0.68	0.36	0.78	0.06	1.26	0.75	1.05
<i>Temperature:Participant.Name</i>	22	0.75	0.84	0.78	0.95	0.57	0.18	1.17	0.61	1.46	0.73
<i>TDS:Percent.Extraction</i>	4	3.38*	1.56	1.24	0.55	0.14	0.46	1.05	0.68	1.31	0.77
<i>TDS:Rep</i>	4	0.08	0.32	1.87	0.11	0.03	0.31	0.23	0.26	0.88	0.26
<i>TDS:Participant.Name</i>	22	0.96	2.14*	1.63*	1.39	2.87*	2.56*	1.93*	4.47*	2.40*	5.62*
<i>Percent.Extraction:Rep</i>	4	0.37	0.58	0.78	0.11	0.21	0.31	0.44	1.01	0.76	1.57
<i>Percent.Extraction:Participant.Name</i>	22	0.59	1.56	1.20	0.51	0.89	0.44	0.86	0.51	1.22	1.93*
<i>Rep:Participant.Name</i>	22	1.00	2.88*	5.52*	3.29*	1.34	2.12*	4.56*	1.41	6.12*	4.72*
<i>Temperature:TDS:Percent.Extraction</i>	8	1.80	0.65	1.88*	0.95	1.18	0.30	0.97	1.64	2.60*	0.79
<i>Temperature:TDS:Rep</i>	8	0.75	0.36	0.82	1.29	2.34*	0.86	0.78	0.88	0.93	0.60
<i>Temperature:TDS:Participant.Name</i>	44	0.62	1.06	0.69	0.85	1.41	1.05	1.21	0.86	1.42*	0.56
<i>Temperature:Percent.Extraction:Rep</i>	8	0.42	0.97	0.89	0.55	1.15	1.07	2.06	0.83	0.50	0.61
<i>Temperature:Percent.Extraction:Participant.Name</i>	44	0.81	1.19	1.52*	0.95	0.82	0.91	1.25	1.00	0.90	1.14
<i>Temperature:Rep:Participant.Name</i>	44	0.63	1.06	1.02	0.62	0.82	0.87	0.79	0.62	1.35	0.85
<i>TDS:Percent.Extraction:Rep</i>	8	0.86	0.52	0.65	0.81	1.37	0.30	0.12	1.06	0.49	0.89
<i>TDS:Percent.Extraction:Participant.Name</i>	44	0.65	1.04	0.70	0.63	1.33	0.82	1.53	0.77	1.74*	0.99
<i>TDS:Rep:Participant.Name</i>	44	1.13	0.82	0.98	0.88	1.20	0.85	1.99*	0.96	0.91	1.16
<i>Percent.Extraction:Rep:Participant.Name</i>	44	0.70	1.00	0.66	1.06	1.07	0.64	1.00	1.36	1.28	1.50*
<i>Temperature:TDS:Percent.Extraction:Rep</i>	16	0.93	1.49	0.83	0.91	0.84	0.79	1.62	0.97	0.89	0.45
<i>Temperature:TDS:Percent.Extraction:Participant.Name</i>	88	0.57	1.04	1.06	0.63	1.02	0.73	1.36	1.04	1.44*	1.03
<i>Temperature:TDS:Rep:Participant.Name</i>	88	0.96	0.95	1.85*	0.79	0.79	0.77	0.78	1.20	1.41*	1.01
<i>Temperature:Percent.Extraction:Rep:Participant.Name</i>	88	0.93	1.03	1.06	0.80	1.04	0.63	0.95	0.86	1.09	0.77
<i>TDS:Percent.Extraction:Rep:Participant.Name</i>	88	0.74	1.05	1.10	0.86	1.01	0.73	1.12	0.77	0.85	0.95

Supplementary Table S3, continued. F-ratios for univariate analysis of variance, significance indicated by * ($\alpha = 0.05$).

Factor:	df	Smoky Flavor	Brown Roast Flavor	Cereal Flavor	Brothy Flavor	Brown Spice Flavor	Nutty Flavor	Dark Chocolate Flavor	Brown Sugar Flavor	Molasses Flavor
<i>Temperature</i>	2	1.18	1.99	0.15	0.05	0.29	4.24*	1.06	0.09	2.08
<i>TDS</i>	2	12.78*	23.52*	2.67	0.15	4.79*	1.23	12.09*	4.80*	8.80*
<i>Percent.Extraction</i>	2	1.37	3.42*	0.90	1.81	0.89	0.84	0.07	0.12	3.21
<i>Rep</i>	2	4.92*	1.67	1.72	0.06	5.36*	20.10*	1.43	0.65	2.84
<i>Participant.Name</i>	11	61.18*	89.97*	225.77*	105.53*	144.5*1	252.51*	28.50*	49.26*	76.55*
<i>Temperature:TDS</i>	4	1.54	2.44	1.13	0.49	3.53*	0.27	1.84	0.62	0.33
<i>Temperature:Percent.Extraction</i>	4	0.64	0.41	0.91	0.19	1.28	0.34	1.60	0.63	0.83
<i>Temperature:Rep</i>	4	0.23	0.78	0.28	0.21	1.22	0.36	0.97	0.36	0.65
<i>Temperature:Participant.Name</i>	22	1.14	1.26	0.49	0.45	0.90	0.50	1.22*	0.61	0.43
<i>TDS:Percent.Extraction</i>	4	1.16	1.12	1.10	1.23	2.38	0.57	3.26	1.51	1.38
<i>TDS:Rep</i>	4	1.05	0.30	0.25	0.75	2.07	0.45	0.92	0.31	1.00
<i>TDS:Participant.Name</i>	22	5.44*	3.53*	0.80	0.94	1.21	0.98	4.04*	2.01*	4.14*
<i>Percent.Extraction:Rep</i>	4	0.41	0.47	1.72	0.46	1.55*	1.22	1.25	2.19	0.48
<i>Percent.Extraction:Participant.Name</i>	22	0.92	0.83	1.19	1.02	1.65*	0.77	1.19	0.61	1.67
<i>Rep:Participant.Name</i>	22	3.48*	2.71*	3.16*	1.98*	4.98	8.60*	3.55*	2.46*	2.91*
<i>Temperature:TDS:Percent.Extraction</i>	8	0.95	0.73	0.28	0.71	0.89	1.20	1.23	0.74	1.25
<i>Temperature:TDS:Rep</i>	8	1.14	1.57	1.00	1.18	2.19*	0.37	1.09	1.35	0.65
<i>Temperature:TDS:Participant.Name</i>	44	0.93	1.24	0.72	0.69	1.29	0.78	1.07	0.63	0.98
<i>Temperature:Percent.Extraction:Rep</i>	8	0.33	2.01	0.48	0.96	0.33	0.98	1.11	0.73	0.62
<i>Temperature:Percent.Extraction:Participant.Name</i>	44	1.06	0.76	1.03	1.04	1.24	0.91	1.10	0.57	0.61
<i>Temperature:Rep:Participant.Name</i>	44	0.73	0.91	0.75	0.70	0.79	0.59	1.11	1.20	0.97
<i>TDS:Percent.Extraction:Rep</i>	8	0.71	2.18*	0.87	1.04	0.81	1.07	1.71	2.11	1.47
<i>TDS:Percent.Extraction:Participant.Name</i>	44	1.19	1.24	0.86	0.88	0.61	0.81	1.85*	0.91	0.65
<i>TDS:Rep:Participant.Name</i>	44	1.24	1.22	0.95	1.51	1.07	0.98	2.22*	0.59	1.39
<i>Percent.Extraction:Rep:Participant.Name</i>	44	1.33	1.60*	0.83	0.58	1.55*	1.03	1.87*	1.00	0.65
<i>Temperature:TDS:Percent.Extraction:Rep</i>	16	1.56	1.54	1.08	0.37	1.14	0.86	1.26	0.98	0.93
<i>Temperature:TDS:Percent.Extraction:Participant.Name</i>	88	1.49	0.91	0.79	1.12	1.19	0.67	0.94	0.68	1.41
<i>Temperature:TDS:Rep:Participant.Name</i>	88	1.16	0.86	0.79	0.74	0.97	0.90	1.24	0.94	0.85
<i>Temperature:Percent.Extraction:Rep:Participant.Name</i>	88	0.91	1.22	0.88	0.84	1.01	0.84	1.11	1.10	1.44
<i>TDS:Percent.Extraction:Rep:Participant.Name</i>	88	0.95	0.90	1.07	0.78	0.81	0.68	1.18	1.10	1.54

Supplementary Table S3, continued. F-ratios for univariate analysis of variance, significance indicated by * ($\alpha = 0.05$).

Attribute	Judge/TDS adjusted F-ratio	Judge/PE adjusted F-ratio
Nutty Aroma	1.70	0.089
Floral Aroma	2.35	0.63
Green/Vegetative Aroma	1.84	0.42
Bitter Taste	25.65*	1.09
Sour Taste	34.91*	20.02*
Sweet Taste	2.23	1.57
Salty Taste	0.23	0.71
Black Tea Flavor	2.81	4.22*
Berry Flavor	5.87*	9.87*
Dried Fruit Flavor	1.14	0.098
Fruity Flavor	1.07	0.37
Citrus Flavor	32.91*	19.62
Fermented Flavor	9.56*	5.99*
Fresh Green Flavor	1.15	2.03
Dark Green Flavor	6.74*	1.05
Woody Flavor	1.68	4.43*
Papery/Musty Flavor	2.20	3.75*
Rubber Flavor	3.79*	1.80
Earthy Flavor	2.86	0.35
Ashy Flavor	5.81*	1.06
Smoky Flavor	2.34	1.5
Brown Roast Flavor	6.66*	4.12*
Cereal Flavor	3.35	0.75
Brothy Flavor	0.16	1.79
Brown Spice Flavor	3.97*	0.54
Nutty Flavor	1.25	1.09
Dark Chocolate Flavor	3.00	0.060
Brown Sugar Flavor	2.39	0.20
Molasses Flavor	2.13	1.93
Astringent Mouthfeel	13.95*	2.60
Viscous Mouthfeel	5.95*	1.16

Supplementary Table S4. F-ratios for pseudomixed analysis of variance for Judge/TDS effect and Judge/PE effect, each with 2 degrees of freedom, significance indicated by * ($\alpha = 0.05$).

Attribute	Total Dissolved Solids			Percent Extraction			Brew Temperature			Fischer's LSD
	1%	1.25%	1.50%	16%	20%	24%	87 °C	90 °C	93 °C	
Nutty Aroma	33.4	33.54	35.4	34.26	34.18	33.91	33.9	34.54	33.91	
Floral Aroma	26.52	27.96	27.12	28.12	26.9	26.57	28.24	28.05	25.31	
Green/Vegetative Aroma	28.68	30.77	28.63	30.03	28.73	29.32	28.84	29.88	29.36	
Bitter Taste	35.26^b	41.68^a	43.59^a	39.29	40.56	40.67	39.41	40.26	40.85	1.74
Sour Taste	33.25^c	41.1^b	46.33^a	44.52^a	39.41^b	36.74^c	40.04	40.33	40.3	1.86
Sweet Taste	22.98	21.29	20.76	22.62	21.09	21.31	22.21	21.46	21.36	
Salty Taste	13.65	13.96	14.13	13.89	14.24	13.6	13.94	13.85	13.94	
Black Tea Flavor	28.09	25.63	25.26	24.24^b	26.79^a	27.94^a	26.88	25.5	26.59	1.67
Berry Flavor	18.65^b	20.3^b	21.6^b	21.47^a	20.77^a	18.31^b	21.1	19.99	19.46	1.66
Dried Fruit Flavor	21.8	23.56	24.2	23.45	23.13	22.98	22.98	23.89	22.69	
Fruity Flavor	17.45	16.39	16.54	16.97	16.93	16.49	17.03	16.6	16.74	
Citrus Flavor	28.25^a	34.53^b	39.8^c	38.41	33.17	31	33.83	33.87	34.88	1.92
Fermented Flavor	13.16^a	15.07^b	16.11^c	15.95	14.11	14.29	14.31	14.96	15.08	1.06
Fresh Green Flavor	20.95	19.92	19.51	20.8	19.67	19.91	19.97	19.87	20.54	
Dark Green Flavor	22.65^b	27.26^a	28.04^a	26.67	25.4	25.89	25.46	26.48	26.02	1.85
Woody Flavor	18.21	19.84	20.76	18.73	19.61	20.47	19.36	19.53	19.91	
Papery/Musty Flavor	16.89	18.76	18.45	17.07	18.24	18.79	17.36	18.23	18.51	
Rubber Flavor	13.71^c	15.8^b	17.82^a	15.91	15.25	16.17	15.81	15.59	15.93	1.39
Earthy Flavor	17.14^b	17.98^b	19.42^a	18.22	18.44	17.87	17.78	18.58	18.18	1.23
Ashy Flavor	18.13^c	22.84^b	25.24^a	21.02	22.54	22.65	21.27	22.17	22.77	1.77
Smoky Flavor	16.5	18.52	20.09	18.9	18.47	17.74	18.04	18.07	19	
Brown Roast Flavor	29.52^c	33.16^b	35.21^a	31.37	33.14	33.38	31.66	33.04	33.19	1.7
Cereal Flavor	21.5	21.36	19.94	20.98	21.41	20.41	21.07	20.7	21.03	
Brothy Flavor	15.41	15.59	15.19	16.14	15.31	14.76	15.47	15.26	15.47	
Brown Spice Flavor	14.34^b	14.68^b	15.79^a	14.95	15.26	14.6	14.77	14.91	15.14	0.97
Nutty Flavor	27.52	26.89	26.4	27.47	26.59	26.76	26.07^b	28.1^a	26.65^b	1.42
Dark Chocolate Flavor	19.72	21.68	23.46	21.46	21.67	21.73	21.06	22.16	21.64	
Brown Sugar Flavor	19.48	17.34	17.17	17.84	18.23	17.93	17.8	18.12	18.08	
Molasses Flavor	14.22	15.17	16.8	16.12	15.51	14.56	15.3	16.07	14.82	
Astringent Mouthfeel	29.88^c	36.19^b	40.49^a	36.88	35.7	33.99	35.16	35.07	36.34	1.69
Viscous Mouthfeel	29.28^b	35^a	35.6^a	32.98	34.43	32.47	32.75	33.77	33.35	1.83

Supplementary Table S5. Mean attribute intensities for all measured variables with Fischer's LSD significance codes, shaded by aromas, basic tastes, flavors, and mouthfeels, in order.