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Supporting Information

Colour development kinetics of Maillard reactions

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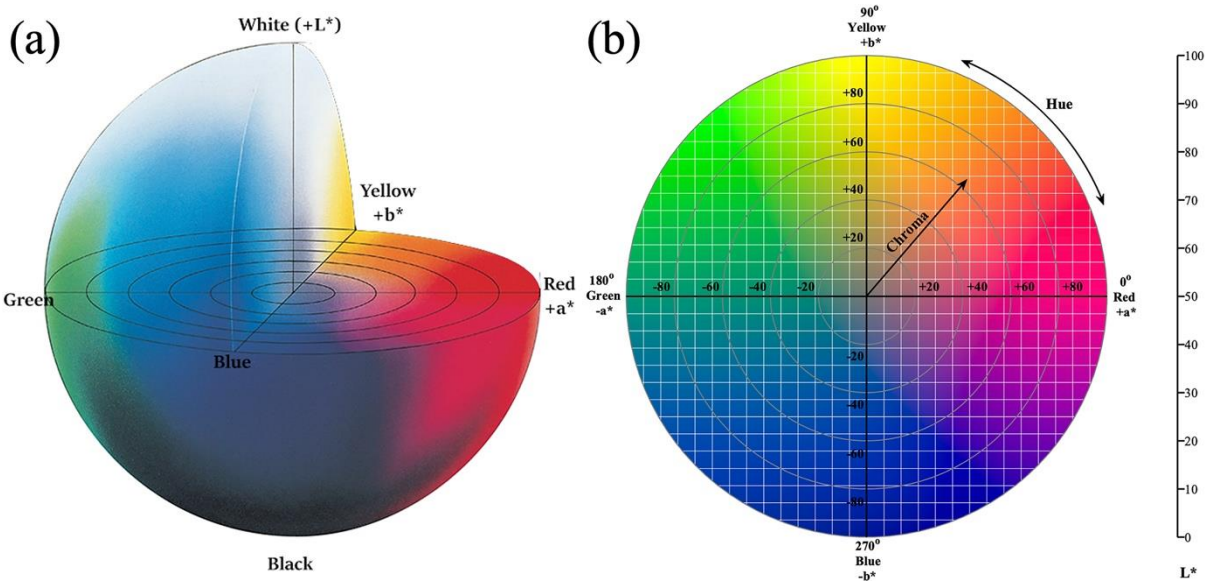

Figure S1.* (*a*) *CIE L*a*b* colour space* (*b*) *axis of a* and b*

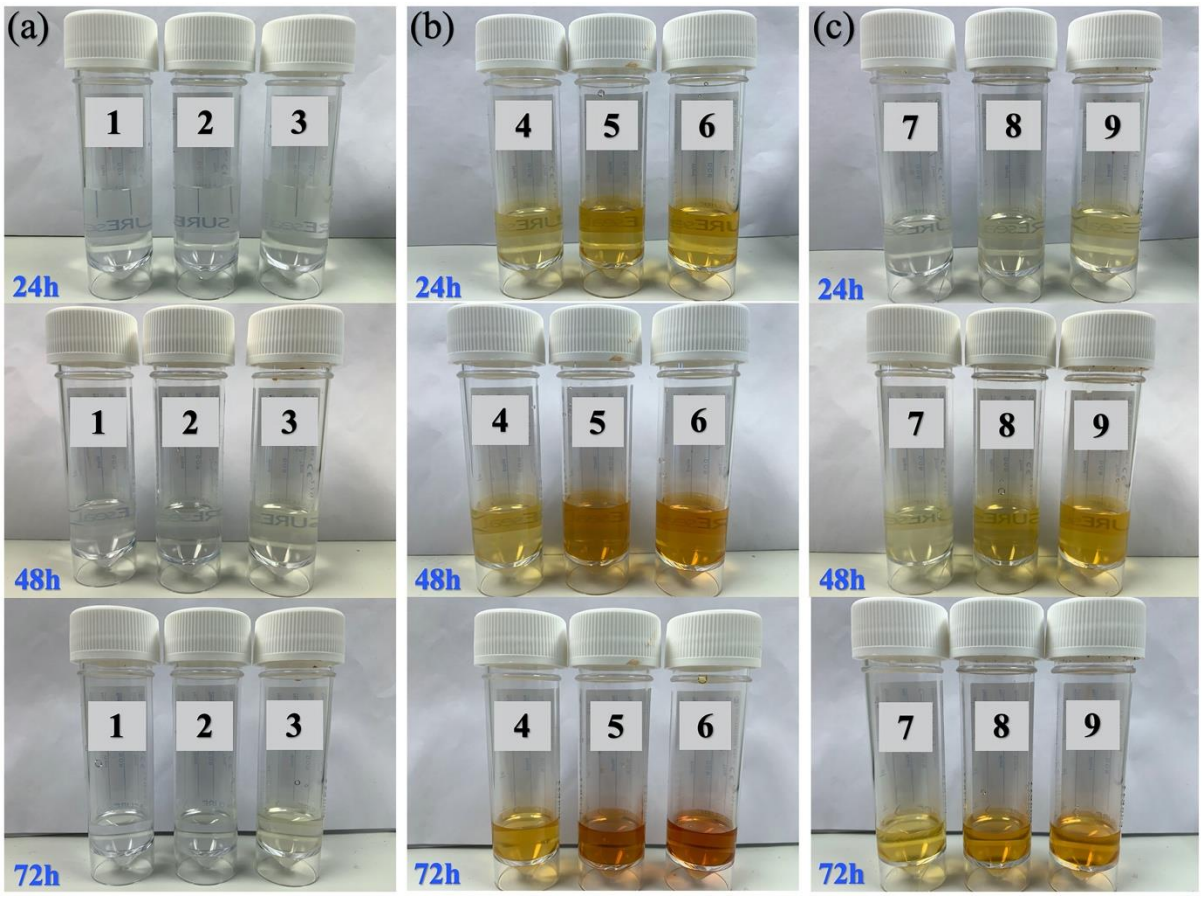

Figure S2. Sample images of (a) Arg-DHA (b) His-DHA (c) Lys-DHA at varying molar ratios (1 to 3, from left to right) and reaction times (24 to 72h, from top to bottom)

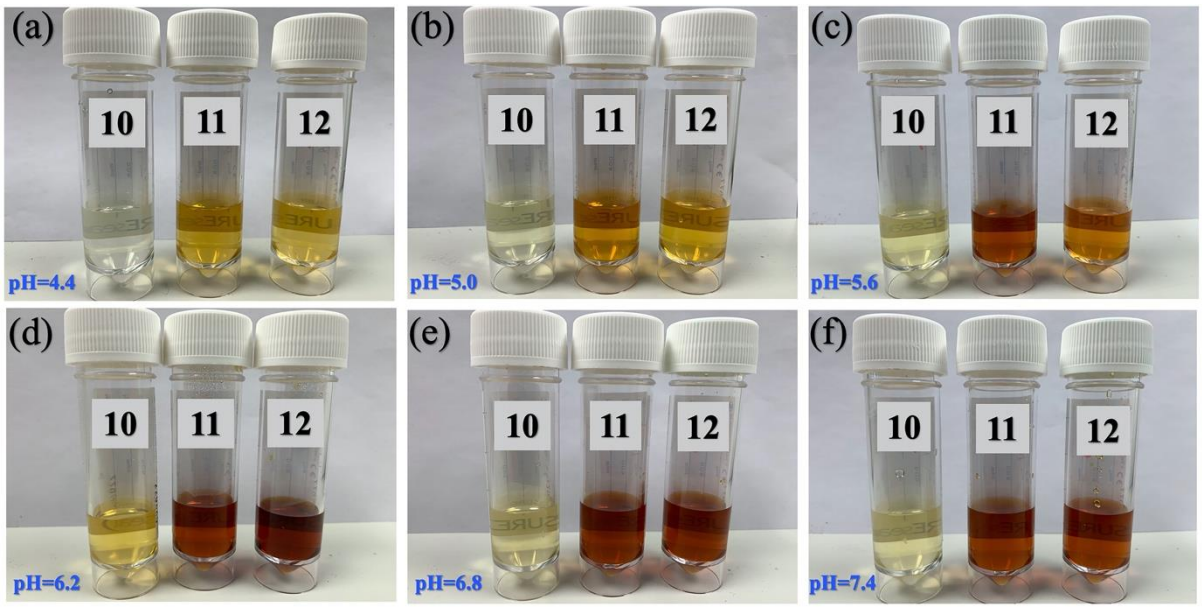

Figure S3. Sample images of AA-DHA (Arg-DHA, His-DHA and Lys-DHA, from left to right) at different pH: (a) 4.4 (b) 5.0 (c) 5.6 (d) 6.2 (e) 6.8 (f) 7.4

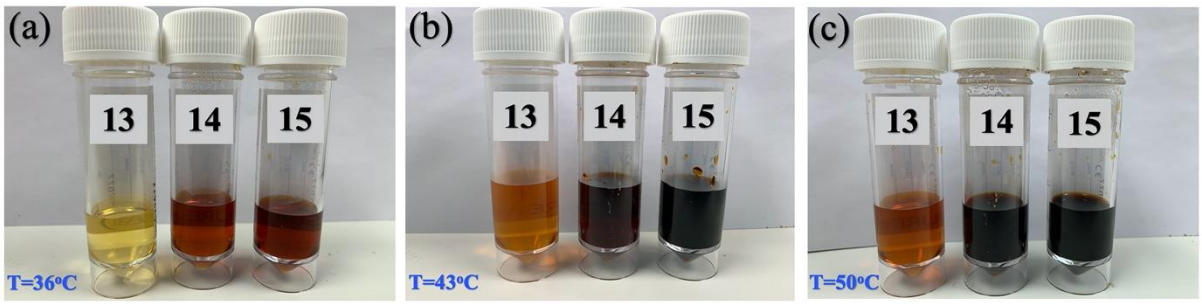

Figure S4. Sample images of AA-DHA (Arg-DHA, His-DHA and Lys-DHA, from left to right) at different temperature: (a) 36 °C (b) 43 °C (c) 50 °C

Table S1. Preparation of acetate and phosphate buffer with different pH values

pH	Sodium Acetate (g)	Acetic acid (g)	$Na_2HPO_4 \cdot 12H_2O$ (g)	$NaH_2PO_4 \cdot 2H_2O$ (g)	H_2O (mL)
4.4	1.663	1.785	—	—	500
5.0	2.762	0.981	—	—	500
5.6	3.861	0.176	—	—	500
6.0	4.192	0.045	—	—	500
6.0	—	—	2.451	6.732	500
6.2	—	—	4.031	6.045	500
6.8	—	—	8.767	4.016	500
7.4	—	—	13.503	1.919	500

Table S2. Factorial design to study the effects of AA type, molar ratio and reaction time on the tanning reaction of AA-DHA

Std Order	Run Order	Pt Type	Blocks	AA type	Molar ratio	Reaction time
7	1	1	1	Arg	3	24
1	2	1	1	Arg	1	24
27	3	1	1	Lys	3	72
25	4	1	1	Lys	3	24
20	5	1	1	Lys	1	48
22	6	1	1	Lys	2	24
18	7	1	1	His	3	72
23	8	1	1	Lys	2	48

19	9	1	1	Lys	1	24
21	10	1	1	Lys	1	72
24	11	1	1	Lys	2	72
8	12	1	1	Arg	3	48
6	13	1	1	Arg	2	72
17	14	1	1	His	3	48
12	15	1	1	His	1	72
9	16	1	1	Arg	3	72
13	17	1	1	His	2	24
5	18	1	1	Arg	2	48
26	19	1	1	Lys	3	48
2	20	1	1	Arg	1	48
10	21	1	1	His	1	24
3	22	1	1	Arg	1	72
16	23	1	1	His	3	24
4	24	1	1	Arg	2	24
15	25	1	1	His	2	72
14	26	1	1	His	2	48
11	27	1	1	His	1	48

Table S3. Preparation of AA-DHA and conditions for studying the effects of AA type, molar ratio and reaction time on the tanning reaction

Samples	DHA (g)	Arg (g)	His (g)	Lys (g)	pH	T (°C)
1	0.270	0.632	—	—	5.0	36
2	0.540	0.632	—	—	5.0	36
3	0.810	0.632	—	—	5.0	36
4	0.270	—	0.629	—	5.0	36
5	0.540	—	0.629	—	5.0	36
6	0.810	—	0.629	—	5.0	36
7	0.270	—	—	0.548	5.0	36
8	0.540	—	—	0.548	5.0	36
9	0.810	—	—	0.548	5.0	36

Table S4. Preparation of AA-DHA and conditions for studying the effects of pH on the tanning reaction

Samples	DHA (g)	Arg (g)	His (g)	Lys (g)	T (°C)	Time (h)
10	0.810	0.632	—	—	36	72
11	0.810	—	0.629	—	36	72
12	0.810	—	—	0.548	36	72

Table S5. Preparation of AA-DHA and conditions for studying the effects of temperature on the tanning reaction

Samples	DHA (g)	Arg (g)	His (g)	Lys (g)	pH	Time (h)
13	0.810	0.632	—	—	6.2	72
14	0.810	—	0.629	—	6.2	72
15	0.810	—	—	0.548	6.2	72

Table S6. Changes in browning intensity and colour characteristics of AA-DHA under pH5.0 heated at 36 °C for different reaction time

Samples	A_{450}			*L**			*a**			*b**		
	24h	48h	72h	24h	48h	72h	24h	48h	72h	24h	48h	72h
1	0.05	0.07	0.09	55.47	54.61	54.70	0.83	0.81	0.76	-4.76	-4.51	-4.32
2	0.06	0.08	0.13	55.15	54.08	54.09	0.64	0.53	0.40	-4.07	-3.18	-3.12
3	0.08	0.12	0.18	56.76	57.14	58.56	0.32	0.03	-0.35	-2.45	-1.09	0.49
4	0.22	0.41	0.83	80.63	84.78	83.14	-2.21	-2.69	-3.33	9.53	12.52	19.22
5	0.43	0.93	1.27	85.34	91.72	79.02	-3.68	-5.19	-1.51	18.91	22.01	44.60
6	0.63	1.14	1.51	85.89	87.08	82.91	-4.05	-5.23	-2.09	21.12	34.91	60.11
7	0.09	0.18	0.84	59.98	67.47	78.12	-0.36	-1.56	-3.03	0.32	6.65	17.21
8	0.11	0.37	1.02	67.97	80.25	81.90	-1.53	-2.90	-3.82	6.36	15.04	30.75
9	0.17	0.58	1.16	74.01	85.16	81.29	-2.22	-3.67	-3.62	10.64	19.68	36.29

Table S7. Changes in browning intensity and colour characteristics of AA-DHA under different pH heated at 36 °C for 72 hours

pH	Arg-DHA				His-DHA				Lys-DHA			
	A_{450}	*L**	*a**	*b**	A_{450}	*L**	*a**	*b**	A_{450}	*L**	*a**	*b**
4.4	0.04	52.28	-0.12	-3.39	0.45	84.99	-3.59	15.78	0.23	67.95	-2.03	8.25
5.0	0.09	58.56	0.35	4.49	0.65	82.91	1.09	30.11	0.58	81.29	1.02	25.29
5.6	0.16	66.39	1.02	7.43	0.77	76.33	3.24	56.16	0.72	79.70	8.33	35.79
6.2	0.26	52.31	1.43	12.63	0.91	65.46	15.84	64.13	0.98	52.32	25.17	45.35
6.8	0.21	56.02	0.77	8.08	0.85	58.50	13.98	52.75	0.87	59.90	14.68	54.46
7.4	0.18	55.16	0.46	7.58	0.79	60.76	12.72	50.39	0.81	61.40	12.24	46.20

Note: A450 values of these samples were obtained after they were diluted 10 times.

Table S8. Browning intensity and colour characteristics of AA-DHA under different buffer composition with same pH heated at 36 °C for 72 hours

pH=6	Arg-DHA				His-DHA				Lys-DHA			
	A_{450}	*L**	*a**	*b**	A_{450}	*L**	*a**	*b**	A_{450}	*L**	*a**	*b**
Acetate	0.21	58.37	1.25	10.58	0.87	71.16	10.86	60.11	0.85	63.46	21.14	41.93
Phosphate	0.20	59.38	1.12	10.24	0.85	72.90	9.97	59.73	0.84	64.71	20.80	40.67

Note: A450 values of these samples were obtained after they were diluted 10 times.

Table S9. Changes in browning intensity and colour characteristics of AA-DHA under different temperatures at pH6.2 for 72 hours

T (°C)	Arg-DHA				His-DHA				Lys-DHA			
	A_{450}	*L**	*a**	*b**	A_{450}	*L**	*a**	*b**	A_{450}	*L**	*a**	*b**
36	0.26	52.31	1.43	12.63	0.91	65.46	15.84	64.13	0.98	52.32	25.17	45.35
43	0.51	58.29	10.72	50.39	1.05	51.84	42.56	23.41	1.11	47.26	47.31	15.79
50	0.63	54.51	14.03	42.75	1.12	48.26	47.28	13.59	1.18	43.35	53.64	10.82

Note: A450 values of these samples were obtained after they were diluted 40 times.