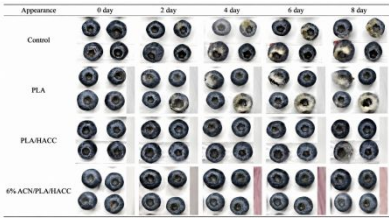
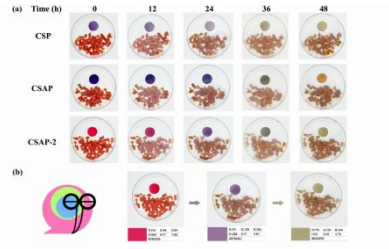
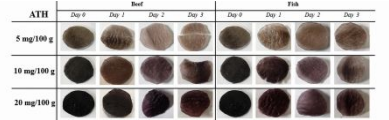
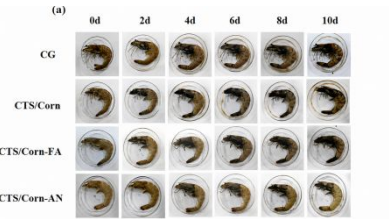
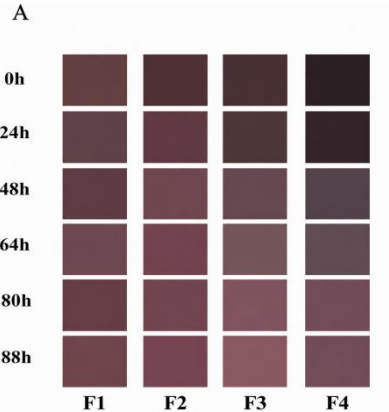
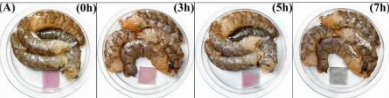
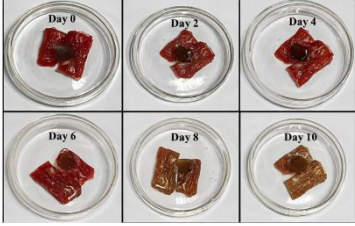
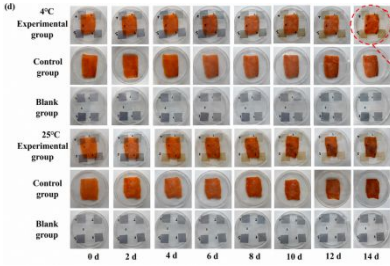
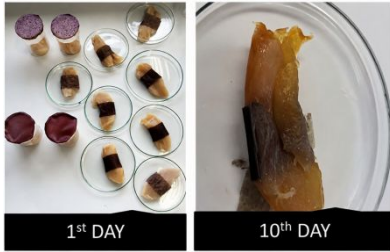
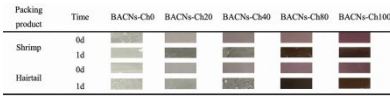
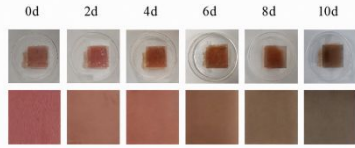
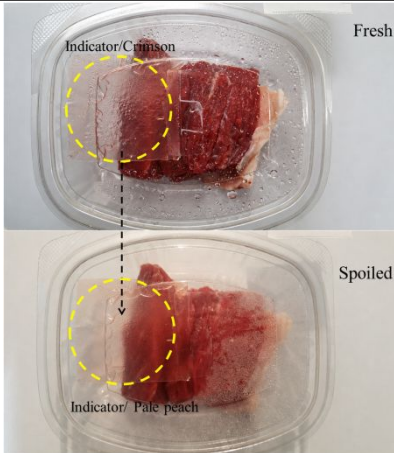
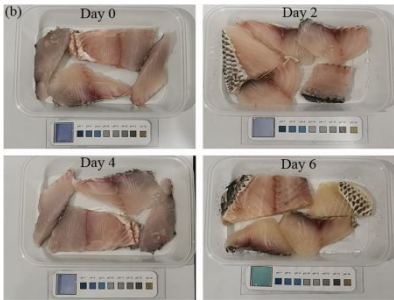


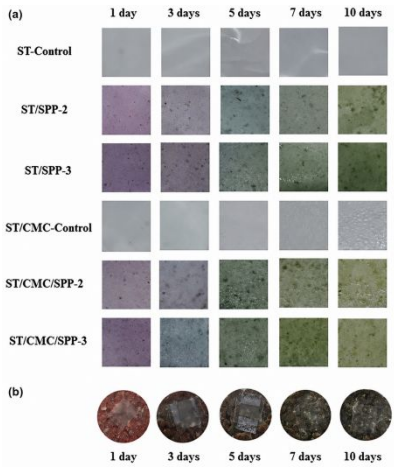
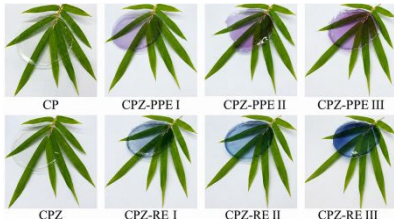
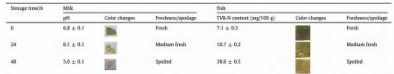
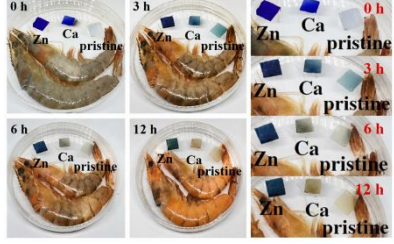
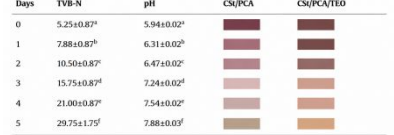
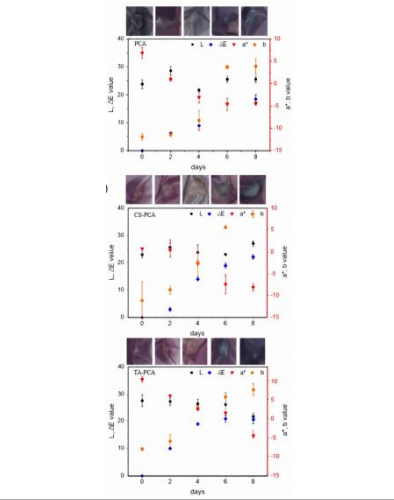
Table S1 Impact of diverse anthocyanins sources on the performance of pH indicator films.

Anthocyanins sources	Matrix	Color change	Application	Reference
Anthocyanin	Polylactic acid		Blueberry	52
Anthocyanin	Chitosan		Pork	60
Anthocyanin	Cassava starch		Meat	61
Anthocyanin	Corn starch		Shrimp	64
Anthocyanin	Cellulose nanocrystals and nano-fibrillated cellulose		Seafood	66
Blueberry	Gelatin		Milk	5
Blueberry	Funoran		Shrimp	47

Blueberry	Sodium alginate	(A) 	Pork	55
Blueberry	Hydroxypropyl methylcellulose- κ -carrageenan-gelatin	(d) 	Salmon meat	63
Blueberry residue	Cassava starch			23
Blueberry waste	Sodium alginate	A  B  C 	Chicken, shrimp, and beef	34
Black rice bran	Oxidized chitin nanocrystals /gelatin		Freshness of seafood	11
Black rice	Gellan gum	(c) 	Fish	42

Blending barberry	Methylcellulose /chitosan nanofiber			Meat and seafood products	31																																																																																
Butterfly pudding	Chitosan			Fish	33																																																																																
Butterfly pea flowers	gelatin	<table><tr><th rowspan="2">Film</th><th rowspan="2">Time (hr)</th><th colspan="3">Color</th><th rowspan="2">ΔE^*</th><th rowspan="2">pH</th></tr><tr><th>ΔL^*</th><th>Δa^*</th><th>Δb^*</th></tr><tr><td></td><td>0</td><td>29.16±0.56</td><td>7.03±0.07</td><td>-3.87±0.23</td><td>0.00±0.00</td><td>5.71±0.01</td></tr><tr><td></td><td>3</td><td>25.00±0.74</td><td>5.43±0.20</td><td>-1.69±0.19</td><td>5.01±1.05</td><td>5.96±0.05</td></tr><tr><td></td><td>6</td><td>24.97±0.02</td><td>3.86±0.28</td><td>-0.43±0.03</td><td>6.30±0.54</td><td>5.98±0.01</td></tr><tr><td></td><td>9</td><td>25.10±0.78</td><td>4.04±0.14</td><td>-0.80±0.02</td><td>5.92±0.09</td><td>6.01±0.05</td></tr><tr><td></td><td>12</td><td>22.98±3.55</td><td>4.22±1.34</td><td>-2.64±0.29</td><td>7.43±2.66</td><td>6.15±0.00</td></tr><tr><td></td><td>15</td><td>34.69±1.06</td><td>4.84±0.15</td><td>-1.45±0.04</td><td>6.48±1.39</td><td>5.70±0.02</td></tr><tr><td></td><td>18</td><td>32.16±0.24</td><td>4.65±0.13</td><td>-1.78±0.17</td><td>4.38±0.14</td><td>5.52±0.01</td></tr><tr><td></td><td>21</td><td>29.09±0.46</td><td>4.32±0.12</td><td>-0.43±0.08</td><td>4.47±0.15</td><td>5.83±0.01</td></tr><tr><td></td><td>24</td><td>29.48±0.95</td><td>4.53±0.25</td><td>-3.33±0.10</td><td>2.72±0.12</td><td>5.98±0.02</td></tr><tr><td></td><td>36</td><td>21.70±0.97</td><td>-3.16±0.25</td><td>12.69±0.94</td><td>20.84±0.89</td><td>7.48±0.06</td></tr></table>		Film	Time (hr)	Color			ΔE^*	pH	ΔL^*	Δa^*	Δb^*		0	29.16±0.56	7.03±0.07	-3.87±0.23	0.00±0.00	5.71±0.01		3	25.00±0.74	5.43±0.20	-1.69±0.19	5.01±1.05	5.96±0.05		6	24.97±0.02	3.86±0.28	-0.43±0.03	6.30±0.54	5.98±0.01		9	25.10±0.78	4.04±0.14	-0.80±0.02	5.92±0.09	6.01±0.05		12	22.98±3.55	4.22±1.34	-2.64±0.29	7.43±2.66	6.15±0.00		15	34.69±1.06	4.84±0.15	-1.45±0.04	6.48±1.39	5.70±0.02		18	32.16±0.24	4.65±0.13	-1.78±0.17	4.38±0.14	5.52±0.01		21	29.09±0.46	4.32±0.12	-0.43±0.08	4.47±0.15	5.83±0.01		24	29.48±0.95	4.53±0.25	-3.33±0.10	2.72±0.12	5.98±0.02		36	21.70±0.97	-3.16±0.25	12.69±0.94	20.84±0.89	7.48±0.06	Beef	40
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Grape skin	Gelling gel	(a) <table><tr><td></td><td>EF</td><td>GSAF</td><td>MGSAF</td><td>MPF111</td><td>MPF311</td><td>MPF131</td><td>MPF113</td></tr><tr><td>day 0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>day 3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>day 6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>day 9</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>day 12</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> <table><tr><td>Day</td><td>Milk pH</td><td>L*</td><td>a*</td><td>b*</td><td>ΔE</td><td colspan="3">pH-sensing film</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td>Milk test</td><td>CIE-Lab</td><td>EWI</td></tr><tr><td>0</td><td>6.69±0.01^a</td><td>55.52±0.42^a</td><td>16.07±0.27^a</td><td>25.00±0.18^a</td><td>-</td><td></td><td></td><td></td></tr><tr><td>4</td><td>4.53±0.13^b</td><td>55.10±0.66^a</td><td>20.29±0.07^b</td><td>21.14±0.53^b</td><td>5.73±0.46^b</td><td></td><td></td><td></td></tr><tr><td>8</td><td>3.74±0.20^c</td><td>54.78±0.19^a</td><td>25.15±0.17^b</td><td>19.83±0.16^b</td><td>10.47±0.15^b</td><td></td><td></td><td></td></tr></table>		EF	GSAF	MGSAF	MPF111	MPF311	MPF131	MPF113	day 0								day 3								day 6								day 9								day 12								Day	Milk pH	L*	a*	b*	ΔE	pH-sensing film									Milk test	CIE-Lab	EWI	0	6.69±0.01 ^a	55.52±0.42 ^a	16.07±0.27 ^a	25.00±0.18 ^a	-				4	4.53±0.13 ^b	55.10±0.66 ^a	20.29±0.07 ^b	21.14±0.53 ^b	5.73±0.46 ^b				8	3.74±0.20 ^c	54.78±0.19 ^a	25.15±0.17 ^b	19.83±0.16 ^b	10.47±0.15 ^b				Chicken breast meat	62
	EF	GSAF	MGSAF	MPF111	MPF311	MPF131	MPF113																																																																																										
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<i>Lycium ruthenicum</i>	Sodium carboxymethylcellulose, sodium alginate, and cassava starch	(B) <table><tr><td></td><td>0d</td><td>1d</td><td>3d</td><td>5d</td><td>7d</td></tr><tr><td>CSC/RA</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CSC/RA/TP1</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CSC/RA/TPM</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CSC/RA/TPH</td><td></td><td></td><td></td><td></td><td></td></tr></table>		0d	1d	3d	5d	7d	CSC/RA						CSC/RA/TP1						CSC/RA/TPM						CSC/RA/TPH						Pork	27																																																															
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Purple sweet potato and red cabbage	Corn starch and polyvinyl alcohol	<table><tr><td></td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>		A	B	C	D	E							Shrimp	4																																																																																	
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Purple-fleshed sweet potato powder	Starch or starch and carboxymethyl cellulose		Beef	56
Purple potato/Roselle	Chitosan/PVA/nano-ZnO		Shrimp	68
Purple tomato	Chitosan		Milk or fish	67
Purple cauliflower	Alginate		Shrimp	30
Purple corn cob	Corn starch-based		Pork	57
Purple cabbage	Gelatin		Fish	69

Plum peel

Sodium
alginate/Gelatin



Chicken

13

Rose

Sodium
alginate/Apricot
peel pectin

Storage period (days)	Fish meat	Sensory characteristics	pH	TVC (log CFU/g)	TVB-N (mg/100 g)	Color change of FRA20 (ΔE)	Images of FRA20
0		Meat surface was not sticky, slightly dry, and the muscle tissue was elastic and tight with a normal smell of fish.	6.69 ± 0.02 ^a	4.28 ± 0.22 ^a	7.24 ± 0.70 ^a	--	
2		Meat surface was not sticky, slightly yellow, and the muscle tissue was elastic and tight with a normal smell of fish.	6.41 ± 0.01 ^a	4.62 ± 0.35 ^{ab}	9.29 ± 1.79 ^{ab}	3.11 ± 0.10 ^a	
4		Meat surface was not sticky, the color became yellowish, and the muscle tissue was elastic and tight with no peculiar smell.	6.78 ± 0.01 ^c	5.04 ± 0.13 ^b	12.02 ± 1.40 ^b	4.01 ± 0.14 ^a	
6		Meat surface was slightly sticky, the color became yellow, and the muscle tissue was less elastic and tight with a slight peculiar smell.	6.89 ± 0.01 ^d	5.69 ± 0.17 ^c	15.20 ± 1.24 ^c	7.52 ± 0.67 ^b	
8		Meat surface was sticky, the color became dark yellow, and the muscle tissue lost its elasticity with a peculiar smell.	7.01 ± 0.03 ^e	6.95 ± 0.11 ^d	19.28 ± 0.35 ^d	9.57 ± 0.79 ^b	
10		Meat surface was stickier, the color was dark yellow, and the muscle tissue lost its elasticity with a strong peculiar smell.	7.14 ± 0.06 ^f	7.86 ± 0.06 ^e	25.01 ± 1.39 ^e	16.96 ± 1.43 ^c	
12		Meat surface was very sticky, the color of the fish was dark yellow, and the meat was turbid with a rancid smell.	7.31 ± 0.01 ^f	8.83 ± 0.12 ^f	29.91 ± 0.64 ^f	20.79 ± 0.98 ^d	
14		Meat surface was extreme sticky, the color of the fish was dark yellow, and the meat severely turbid with	7.52 ± 0.01 ^h	9.32 ± 0.28 ^f	35.94 ± 2.10 ^f	32.75 ± 2.93 ^e	

Grass
carp

65