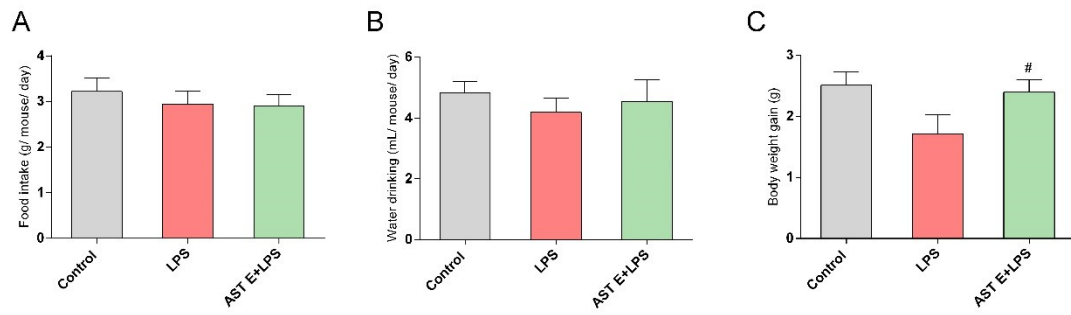


**Figure S1.** The schematic diagram of the formation process of astaxanthin-loaded layer-by-layer emulsions.



**Figure. S2** Effect of astaxanthin emulsion on body weight and dietary water intake of LPS-induced mice. (A): food intake; (B): water intake; (C): body weight gain. Data presented as mean  $\pm$  SEM, n=10. # $p < 0.05$ , versus LPS mice group.

	Forward primer	Reverse primer
<i>GAPDH</i>	TGGAGAAACCTGCCAAGTATGA	TGGAAGAATGGGAGTTGCTGT
<i>COX-2</i>	GAAGTCTTTGGTCTGGTGCCT	GCTCCTGCTTGAGTATGTCG
<i>iNOS</i>	GGAGCGAGTTGTGGATTG	CCAGGAAGTAGGTGAGGG
<i>TNF-α</i>	CCCTCACACTCAGATCATCTTCT	GCTACGACGTGGGCTACAG
<i>IL-1β</i>	TGACGGACCCCAAAGATGA	TCTCCACAGCCACAATGAGT
<i>IL-6</i>	TTCCATCCAGTTGCCTTCTTG	TATCCTCTGTGAAGTCTCCTCTC
<i>IL-10</i>	GCTCCAAGACCAAGGTGTCTACAA	CCGTTAGCTAAGATCCCTGGATCA
<i>HO-1</i>	ATGTGGCCCTGGAGGAGGAGA	CGCTGCATGGCTGGTGTGTAG
<i>NQO-1</i>	GGATTGGACCGAGCTGGAA	AATTGCAGTGAAGATGAAGGCAAC
<i>MMP9</i>	CATTCGCGTGGATAAAGGAGT	ACCTGGTTCACCTCATGGTC
<i>BDNF</i>	CTCCGCCATGCAATTTCCACT	GCCTTCATGCAACCGAAGTA
<i>NT-3</i>	GTTCCAGCCAATGATTGCAA	GGGCGAATTGTAGCGTCTCT
<i>NT-4</i>	CAAGGCTAAGCAGTCCTATGT	CAGTCATAAGGCACGGTAGAG
<i>PSD-95</i>	TCTGTGCGAGAGGTAGCAGA	AAGCACTCCGTGAACTCCTG
<i>SNAP-25</i>	CTGGCTGATGAGTCCCTGG	GACCGACTACTCAGGGACC

Table S1. Primer sequences used for qRT-PCR analysis

Table S2. Components of secondary structures of lactoferrin heated at different temperatures

Thermal treatment condition	Content of different secondary structures (%)			
	$\alpha$ -Helical	$\beta$ -Sheet	$\beta$ -Turns	Random coil
25°C	23.83	24.11	17.35	34.71
70°C	17.4	33.6	21.4	27.3
95°C	12.29	38.0	21.20	29.1

Table S3. AST content (mg/mL) in different AST emulsions during photodegradation kinetic test

Time /min	25°C LF	70°C LF	95°C LF	95°C LF-CMCS	95°C LF-BP
0	1.5000	1.5000	1.5000	1.5000	1.5000
10	1.3120	1.4350	1.42401	1.4673	1.4523
20	1.2079	1.3944	1.3423	1.2760	1.4128
30	0.9946	1.3217	1.3228	1.1848	1.3461
40	0.9443	1.1788	1.2420	1.1748	1.2808
60	0.8730	1.0315	1.1758	1.0534	1.2286
90	0.7312	0.9812	1.0967	0.9398	1.2093
120	0.7716	0.9981	1.0235	0.9207	1.2103
150	0.7261	0.9805	0.9882	0.9431	1.1678
180	0.6188	0.9507	1.0001	0.8458	1.1286
210	0.6299	0.8569	0.9414	0.7621	1.0292
240	0.6113	0.7767	0.8822	0.7271	0.9347
270	0.5778	0.7088	0.9109	0.6338	0.9116
300	0.5549	0.6932	0.8259	0.6458	0.9074
330	0.4369	0.6254	0.8293	0.6187	0.9171
360	0.3647	0.5775	0.7245	0.6107	0.8007
390	0.3068	0.5344	0.6549	0.5540	0.7824
420	0.2947	0.4994	0.5951	0.4873	0.7232
450	0.2564	0.4439	0.5463	0.4467	0.6623
480	0.2254	0.3783	0.5240	0.3548	0.5907

Table S4. Half-lives for photodegradation kinetic of AST in different emulsions

Sample	25°C LF	70°C LF	95°C LF	95°C LF-CMCS	95°C LF-BP
$t_{1/2}$ (min)	208.152	276.154	359.144	281.767	412.588

Table S5. Effects of AST emulsion on the body and tissues weight of LPS-induced C57BL/6J mice

Note: Data presented as mean  $\pm$  SEM, n=10. \* $p$  < 0.05, \*\* $p$  < 0.01, versus Control mice group. # $p$  < 0.05, versus LPS mice group.

	Control	LPS	AST E+LPS
Body Weight (g)	24.16 $\pm$ 1.37	23.56 $\pm$ 1.25	23.61 $\pm$ 1.32
Liver (g)	1.00 $\pm$ 0.08	1.28 $\pm$ 0.11	1.03 $\pm$ 0.04
Spleen (g)	0.065 $\pm$ 0.02	0.14 $\pm$ 0.02**	0.11 $\pm$ 0.03#
Kidney (g)	0.28 $\pm$ 0.03	0.30 $\pm$ 0.03	0.28 $\pm$ 0.04
Brain (g)	0.16 $\pm$ 0.01	0.15 $\pm$ 0.06	0.12 $\pm$ 0.02