Table S1 Flavor attributes with definitions, and reference materials used for taste profile analysis.

Flavor attribute	Definitions	Reference materials
Caramel-like	caramel flavor associated with burned sugar	0.01 g/L 4-hydroxy-2,5 dimethyl-3(2H) furanone
Bitterness	bitter taste felt in back side of the tongue	0.15 g/L quinine
Salty	salty taste	2.0 g/L NaCl
Sourness	puckering up of mouth	1.5 g/L citric acid
Fishy taste	undesired earthy flavor commonly found in freshwater fish	-
Umami	flavor associated with umami	1.0 g/L monosodium glutamate
Kokumi	a comprehensive taste containing thickness, richness, and fullness	5.0 mmol/L reduced glutathione in chicken breast soup

Table S2 The sensitive objects corresponding to 10 E-nose sensors**.**

Sensor Name	Object Substances of Sensing
W1C	Aromatic 1
W5S	Broad-range
W3C	Aromatic 2
W6S	Hydrogen
W5C	Aroma-aliph
W1S	Broad-methane
W1W	Sulfur-organic
W2S	Broad-alcohol
W2W	Sulfur-chlor
W3S	Methane-aliph

Table S3 The intermediate products, browning intensity, reducing power, ferric reducing/antioxidant power (FRAP), DPPH radical scavenging activity, and oxygen radical absorbance capacity (ORAC) of different oligosaccharides heated alone. XOS, xylo-oligosaccharide; GOS, galacto-oligosaccharides; FOS, fructo-oligosaccharide; STA, stachyose; IOS, isomalto-oligosaccharide.

	XOS-Heated	**GOS-Heated**	**FOS-Heated**	**STA-Heated**	**IOS-Heated**
Intermediate products (OD_{294nm})	0.007±0.001a	0.003±0.001c	0.001±0.001c	0.007±0.001a	0.005±0.001b
Browning intensity (OD_{420nm})	0.002±0.001b	0.002±0.001b	0.003±0.001b	0.012±0.003a	0.005±0.001b
Reducing power ($OD_{700\ nm}$)	0.032±0.016ab	0.028±0.004b	0.048±0.022ab	0.058±0.015a	0.038±0.013ab
FRAP (mM $FeSO_4$/mg sample)	0.030±0.003a	0.023±0.001a	0.006±0.006b	0.031±0.005a	0.024±0.013a
DPPH radical scavenging (μM TE/mg sample)	0.941±0.241a	1.535±0.617a	2.198±0.173a	1.432±0.145a	1.158±0.242a
ORAC (mM TE/mg sample)	0.039±0.002b	0.037±0.002b	0.043±0.001a	0.038±0.004b	0.041±0.002ab

Table S4 Molecular weight distribution of MRPs prepared by different oligosaccharides, ASCH, and PSCH.

Samples	＜500 Da (%)	500-1000 Da (%)	1000-2000 Da (%)	2000-3000 Da (%)	3000-5000 Da (%)	＞5000 Da (%)
Unhydrolyzed	26.61±0.05k	1.44±0.09k	2.10±0.02i	1.96±0.02e	3.92±0.04a	63.98±0.09a
ASCH	46.81±0.03j	25.43±0.04b	17.19±0.02a	5.97±0.06a	3.87±0.02a	0.74±0.03b
ASCH-Heated	68.90±0.05g	18.32±0.14c	9.19±0.08d	2.62±0.09c	0.86±0.09d	0.11±0.01d
ASCH-XOS	68.49±0.06h	17.51±0.08e	9.58±0.11c	2.98±0.04b	1.24±0.04b	0.21±0.02c
ASCH-GOS	69.20±0.11f	18.15±0.05c	9.11±0.13d	2.57±0.01c	0.84±0.02d	0.14±0.03d
ASCH-FOS	69.02±0.14fg	18.14±0.03c	9.22±0.15d	2.63±0.06c	0.88±0.08d	0.12±0.01d
ASCH-STA	69.52±0.10f	17.90±0.06d	9.06±0.08de	2.56±0.06c	0.85±0.03d	0.12±0.02d
ASCH-IOS	70.44±0.08e	17.41±0.04e	8.79±0.26e	2.43±0.04d	0.81±0.04d	0.12±0.01d
PSCH	54.44±0.09i	27.34±0.08a	14.15±0.11b	2.99±0.03b	0.97±0.05c	0.11±0.02d
PSCH-Heated	88.48±0.05a	9.70±0.06j	1.78±0.12j	0.05±0.03h	0.04±0.01g	0.01±0.01e
PSCH-XOS	77.72±0.02d	15.06±0.15g	5.85±0.09f	1.05±0.04f	0.31±0.04e	0.02±0.01e
PSCH-GOS	79.30±0.12b	14.76±0.06h	5.01±0.12h	0.73±0.06g	0.18±0.03f	0.01±0.01e

PSCH-FOS	78.46±0.06c	15.27±0.14g	5.28±0.08g	0.77±0.02g	0.19±0.06f	0.02±0.01e
PSCH-STA	79.67±0.09b	14.50±0.05i	4.92±0.14h	0.72±0.02g	0.18±0.04f	0.02±0.01e
PSCH-IOS	77.94±0.07d	15.64±0.03f	5.42±0.11g	0.79±0.01g	0.20±0.01f	0.02±0.01e

Different lowercase letters indicate the significant difference ($p < 0.05$). ASCH, whole silver carp hydrolysates prepared by alcalase; PSCH, whole silver carp hydrolysates prepared by papain; XOS, xylo-oligosaccharide; GOS, galacto-oligosaccharides; FOS, fructo-oligosaccharide; STA, stachyose; IOS, isomalto-oligosaccharide.

Table S5 Volatile compounds identified in hydrolysates and their MRPs.

Compounds	CAS number	Molecular formula	Retention index	Retention time (s)	Drift time (ms)
		Aldehyde			
Methional	3268-49-3	C4H8OS	942.3	168.434	1.405
Phenylacetaldehyde	122-78-1	C8H8O	1062.8	275.38	1.255
Anisaldehyde	123-11-5	C8H8O2	1255.1	614.842	1.669
(E, E)-2,4-Decadienal	25152-84-5	C10H16O	1257.3	620.372	1.412
		Ketone			
2-Heptanone	110-43-0	C7H14O	893.9	138.722	1.243
Acetophenone	98-86-2	C8H8O	1060.5	272.772	1.561
1-(4-methylphenyl)-Ethanone	122-00-9	C9H10O	1157.4	408.029	1.694
Isomenthone	491-07-6	C10H18O	1113.1	339.287	1.335
		Esters			
2-Methylbutanol acetate	624-41-9	C7H14O2	874.5	128.438	1.284
2-Methylpropyl butanoate	539-90-2	C8H16O2	939.1	166.26	1.330
Benzyl acetate	140-11-4	C9H10O2	1156.1	405.803	1.329
Isopentyl isovalerate	659-70-1	C10H20O2	1080.4	296.248	1.458
2-Phenyl ethyl acetate	103-45-7	C10H12O2	1258.1	622.583	1.808
Citronellyl acetate	150-84-5	C12H22O2	1316.7	797.348	1.474
Isobornyl acetate	125-12-2	C12H20O2	1320.9	811.442	1.201
		Heterocyclic compound			
4,5-Dihydro-3(2H)-thiophenone	1003-04-9	C4H6OS	969.5	187.997	1.179
2-Furanmethanol	98-00-0	C5H6O2	836.4	110.613	1.122
2-Acetylfuran	1192-62-7	C6H6O2	871.9	127.134	1.114
5-Methyl-2-furanmethanol	3857-25-8	C6H8O2	939.1	166.26	1.264
5-Ethyl-4-hydroxy-2-	27538-09-6	C7H10O3	1063.2	275.889	1.346

methyl-3(2H)-furanone					
Benzothiazole	95-16-9	C7H5NS	1221.7	534.108	1.152
2-n-Butylfuran	4466-24-4	C8H12O	891.8	137.567	1.184
2-Pentylfuran	3777-69-3	C9H14O	1011.2	222.777	1.241
Aromatic compounds					
Phenol	108-95-2	C6H6O	974.1	191.475	1.047
Aniline	62-53-3	C6H7N	971.4	189.456	1.420
1,2-Dimethylbenzene	95-47-6	C8H10	834.4	109.744	1.048
Styrene	100-42-5	C8H8	891.8	137.567	1.052
Others					
2-Methylbutyric acid	116-53-0	C5H10O2	865.7	124.09	1.202
Diethylene glycol dimethyl ether	111-96-6	C6H14O3	936.5	164.521	1.171
Camphene	79-92-5	C10H16	969	187.563	1.213
Undecane	1120-21-4	C11H24	1118	346.243	1.085

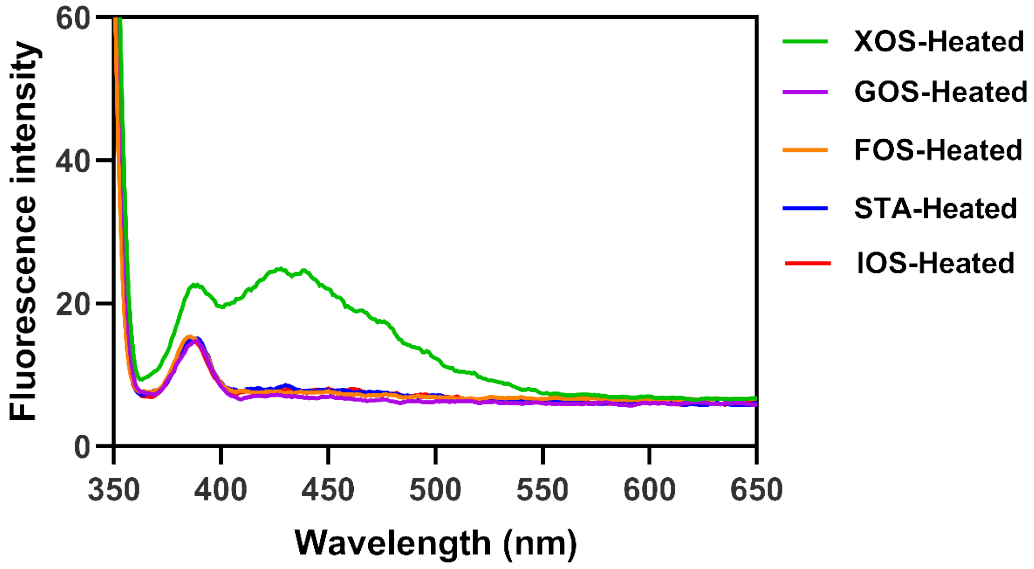

Fig. S1 The fluorescence spectra of different oligosaccharides heated alone. XOS, xylo-oligosaccharide; GOS, galacto-oligosaccharides; FOS, fructo-oligosaccharide; STA, stachyose; IOS, isomalto-oligosaccharide.

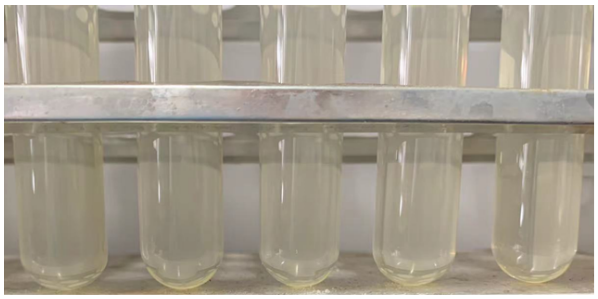

Fig. S2 The images of different oligosaccharides heated alone. GOS, galacto-oligosaccharides; XOS, xylo-oligosaccharide; FOS, fructo-oligosaccharide; IOS, isomalto-oligosaccharide; STA, stachyose.