**Supplementary Materials**



**Fig. S1.** HPLC chromatograms (detected at 280 nm) of standards of EGCG (A) and thiolyzed BLPs (B). Peak 1: EGCG cysteamine thioether (thio-EGCG); peak 2: EGCG.

**Table S2.** Fractions from BLPs and their identification from normal-phase preparative HPLC-ESI/MS and reverse-phase HPLC-ESI/MS.

|  |  |  |  |
| --- | --- | --- | --- |
| Fractionsa | Yieldb (mg/200mg) | MW (g/mol)c | Tentative identificationd |
| 1 | 10.8±0.3 | 616 | myricetin deoxyhexoside-gallate |
| 2 | 4.6±0.1 | 744, 882 | (E)GC+(E)CG, 2(E)CG, 2(E)C+(E)GC |
| 3 | 8.6±0.3 | 762 | (E)GC+(E)GCG |
| 4 | 8.6±0.4 | 914 | 2(E)GCG |
| 5 | 4.3±0.2 | 1066 | 2(E)GC+(E)GCG |
| 6 | 8.7±0.2 | 1218 | (E)GC+2(E)GCG |
| 7 | 13.0±1.5 | 1371 | 3(E)GCG, 3(E)GC+(E)GCG |
| 8 | 19.6±0.6 | 1523 | 2(E)GC+2(E)GCG |
| 9 | 32.2±1.6 | 1675 | (E)GC+3(E)GCG |
| 10 | 43.8±1.0 | 1827 | 3(E)CG+(E)GCG, 4(E)GCG |

a Fractions, Fractions and their identification from normal-phase preparative HPLC- ESI/MS and reverse-phase HPLC-ESI/MS.

b Yield, the yield of one injection of preparative HPLC, that is, milligram per 200 milligrams BLPs.

c MW, molecular weight.

d Tentative identification, (E)GC, (E)GCG, (E)CG are abbreviations for (epi)gallocatechin, (epi)gallocatechin-3-O-gallate, (epi)catechin-3-O-gallate.

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**Fig. S2.** Developmental rate of *Drosophila* from egg to adult lifecycle (egg-embryo-1st instar larva-2nd instar larvae-3rd instar larvae-prepupa-pupa-adult) with normal diet (ND) and 20%-40% high-sugar diet (HSD) feeding. (A)-(E) represented the record on the 4th, 7th, 9th, 12th and 13th day after HSD treatment, corresponding to the first time observing L1&L2 larvae, L3 larvae, pre-pupa, pupa, and adult in the ND group. Meantime, developmental delay of 2-3 days in 30% HSD group. Here, 40% HSD feeding was observed stop-growing at the stage of L3 larvae and even cannot reach the pupal state and turn into flies in further thirty days.

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**Fig. S3.** Total weight (ten of flies) (A), body glucose content (B), hemolymph glucose content (C), and total triglyceride content (D) of flies fed on a high-sugar diet from egg-stage (HSD-E treatment). Significance is marked as \* p < 0.05, \*\* p < 0.01 and \*\* p < 0.001 compared to the normal diet (ND) control, ## p < 0.01 and ### p < 0.001 between two HSD groups when represented with lines.

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**Fig. S4.** α-Amylase and α-glucosidase activity (A) and mRNA expression change of *Amy* and *Mal-5b* genes (B) of flies fed on a high-sugar diet from egg-stage (HSD-E treatment). Significance is marked as \* p < 0.05 and \*\* p < 0.01 compared to the ND control, ## p < 0.01 between two HSD groups when represented with lines, and n.s. represented no significance between groups here.



**Fig.S5.** mRNA expression of main genes related to glucose and lipid metabolism in flies fed on a high-sugar diet from egg-stage (HSD-E treatment). Significance is marked as \* p < 0.05, \*\* p < 0.01 and \*\* p < 0.001 compared to the normal diet (ND) control group.

**Data Tables:**

**Table A.** Body weight (ten flies), body glucose content, and total triglyceride content of those flies fed on a diet containing BLPs at differentconcentrations in pre-treatment or post-treatment, respectively. (corresponding to the data in Fig.3)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Treatment | Groups | Body weight of ten flies (mg) | Body glucose content (μg/μg pro) | Total triglyceride content (μg/μg pro) |
| pre-treatment | ND | 10.63±0.35a | 0.08±0.03c | 0.15±0.04c |
| HSD | 9.48±0.25b | 0.32±0.02a | 0.71±0.02a |
| 0.1%BLPs/HSD | 9.36±0.42bc | 0.20±0.04b | 0.66±0.03a |
| 0.2%BLPs/HSD | 9.03±0.71bc | 0.19±0.03b | 0.65±0.11a |
| 0.5%BLPs/HSD | 8.82±0.60c | 0.12±0.04c | 0.37±0.10b |
| post-treatment | ND+ND | 11.16±0.56a | 0.61±0.06b | 0.57±0.04b |
| HSD+ND | 11.32±0.17a | 0.71±0.03a | 0.76±0.09a |
| HSD+0.1%BLPs/ND | 11.06±0.48a | 0.51±0.04c | 0.45±0.07c |
| HSD+0.2%BLPs/ND | 10.82±0.51a | 0.40±0.04d | 0.42±0.11cd |
| HSD+0.5%BLPs/ND | 10.11±0.33b | 0.38±0.03d | 0.31±0.03d |

Data (Mean ± SD) in the same column with different letters (a, b, c, d) were significantly different (*p* < 0.05).

**Table B.** α-Amylase activity and α-glucosidase activity of those flies fed on a diet containing BLPs at different concentrations in pre-treatment or post-treatment, respectively. (corresponding to the data in Fig.4)

|  |  |  |  |
| --- | --- | --- | --- |
| Treatment | Groups | α-Amylase activity (U/mg pro) | α-Glucosidase activity (U/mg pro) |
| pre-treatment | ND | 0.47±0.10ab | 0.83±0.02b |
| HSD | 0.50±0.05ab | 1.16±0.10a |
| 0.1%BLPs/HSD | 0.53±0.05a | 0.35±0.01c |
| 0.2%BLPs/HSD | 0.45±0.02ab | 0.28±0.03c |
| 0.5%BLPs/HSD | 0.40±0.04b | 0.30±0.03c |
| post-treatment | ND+ND | 0.73±0.06b | 0.89±0.07a |
| HSD+ND | 1.05±0.17ab | 0.93±0.05a |
| HSD+0.1%BLPs/ND | 1.17±0.37a | 0.45±0.13b |
| HSD+0.2%BLPs/ND | 0.95±0.12ab | 0.45±0.04b |
| HSD+0.5%BLPs/ND | 0.76±0.01b | 0.58±0.03b |

Data (Mean ± SD) in the same column with different letters (a, b, c, d) were significantly different (*p* < 0.05).

**Table C.** mRNA expression of *Amy* gene and *Mal-5b* gene of those flies fed on media containing BLPs at different concentrations in pre-treatment and post-treatment, respectively. (corresponding to the data in Fig.5)

|  |  |  |  |
| --- | --- | --- | --- |
| Treatment | Groups | Fold change of *Amy* mRNA expression | Fold change of *Mal* mRNA expression |
| pre-treatment | ND | 1.00±0.06ab | 1.00±0.05a |
| HSD | 1.05±0.08ab | 1.03±0.04a |
| 0.1%BLPs/HSD | 1.00±0.14ab | 0.72±0.01b |
| 0.2%BLPs/HSD | 1.12±0.03a | 0.50±0.15c |
| 0.5%BLPs/HSD | 0.94±0.09b | 0.35±0.04d |
| post-treatment | ND+ND | 1.01±0.18a | 1.01±0.12a |
| HSD+ND | 0.85±0.29ab | 1.07±0.15a |
| HSD+0.1%BLPs/ND | 0.66±0.03bc | 0.57±0.04b |
| HSD+0.2%BLPs/ND | 0.66±0.10bc | 0.70±0.22b |
| HSD+0.5%BLPs/ND | 0.47±0.01c | 0.77±0.07b |

Data (Mean ± SD) in the same column with different letters (a, b, c, d) were significantly different (*p* < 0.05).

**Table D.** mRNA expression of main genes associated with glucose metabolism of those flies fed on media containing BLPs at different concentrations. (corresponding to the data in Fig.6)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Treatment | Groups | *dilp2* | *dilp3* | *InR* | *dAKT* | *dTOR* | *dFOXO* | *PEPCK* | *MAPK* |
| pre-treatment | ND | 1.00±0.02bc | 1.04±0.33b | 1.01±0.15b | 1.01±0.16b | 1.02±0.21b | 1.00±0.11a | 1.05±0.37c | 1.00±0.07b |
| HSD | 1.12±0.04ab | 1.75±0.45a | 1.38±0.10a | 2.06±0.41a | 1.56±0.23a | 1.16±0.36a | 3.06±0.33a | 1.57±0.04a |
| 0.1%BLPs/HSD | 1.21±0.13a | 1.60±0.24a | 0.85±0.10b | 0.64±0.15bc | 0.79±0.29b | 0.35±0.20b | 1.40±0.44bc | 0.67±0.04c |
| 0.2%BLPs/HSD | 0.83±0.16c | 1.64±0.25a | 0.52±0.10c | 0.42±0.11cd | 0.75±0.22b | 0.28±0.07b | 2.03±0.63b | 0.42±0.07d |
| 0.5%BLPs/HSD | 0.46±0.17d | 1.59±0.16a | 0.23±0.03d | 0.12±0.00d | 0.08±0.06c | 0.10±0.07b | 0.79±0.51c | 0.15±0.06e |
| post-treatment | ND+ND | 1.01±0.17b | 1.01±0.15b | 1.00±0.10b | 1.00±0.06a | 1.02±0.23ab | 1.00±0.08a | 1.00±0.06b | 1.00±0.09b |
| HSD+ND | 1.36±0.14a | 1.88±0.67a | 1.25±0.30a | 1.05±0.08a | 1.31±0.02a | 0.80±0.15b | 1.55±0.30a | 1.72±0.33a |
| HSD+0.1%BLPs/ND | 0.93±0.23b | 1.46±0.07ab | 0.17±0.04c | 0.53±0.07b | 1.11±0.24ab | 0.18±0.01d | 0.65±0.07c | 1.47±0.17a |
| HSD+0.2%BLPs/ND | 0.87±0.10b | 1.22±0.19b | 0.37±0.04c | 0.53±0.06b | 0.85±0.05c | 0.49±0.05c | 1.07±0.22b | 1.10±0.04b |
| HSD+0.5%BLPs/ND | 0.87±0.20b | 1.15±0.30b | 0.23±0.05c | 0.41±0.05c | 0.96±0.29c | 0.54±0.03c | 1.01±0.13b | 0.71±0.08c |

Data (Mean ± SD) in the same column with different letters (a, b, c, d) were significantly different (*p* < 0.05).

**Table E.** mRNA expression of main genes associated with lipid metabolism of those flies fed on media containing BLPs at different concentrations. (corresponding to the data in Fig.7)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Treatment | Groups | *E78* | *SREBP* | *FAS* | *LSD* |
| pre-treatment | ND | 1.04±0.34a | 1.03±0.28a | 1.01±0.19b | 1.00±0.10b |
| HSD | 1.23±0.43a | 1.20±0.30a | 1.48±0.38a | 2.09±0.38a |
| 0.1%BLPs/HSD | 0.82±0.21a | 0.48±0.16b | 0.88±0.06b | 1.30±0.22b |
| 0.2%BLPs/HSD | 0.75±0.36a | 0.89±0.33ab | 1.37±0.09a | 0.97±0.30b |
| 0.5%BLPs/HSD | 0.10±0.06b | 0.86±0.21ab | 0.47±0.14c | 0.06±0.03c |
| post-treatment | ND+ND | 1.02±0.24a | 1.01±0.12b | 1.00±0.10b | 1.01±0.17b |
| HSD+ND | 1.08±0.38a | 1.43±0.28a | 1.75±0.09a | 1.79±0.13a |
| HSD+0.1%BLPs/ND | 0.51±0.32bc | 0.73±0.15b | 1.17±0.08b | 0.49±0.07c |
| HSD+0.2%BLPs/ND | 0.87±0.19ab | 1.41±0.20c | 1.18±0.11b | 1.05±0.37b |
| HSD+0.5%BLPs/ND | 0.33±0.07c | 0.91±0.14b | 1.02±0.22b | 0.48±0.12c |

Data (Mean ± SD) in the same column with different letters (a, b, c, d) were significantly different (*p* < 0.05).

**Table F.** Total weight (ten flies), body glucose content, hemolymph glucose content, and total triglyceride content of flies fed on a high-sugar diet from egg-stage (HSD-E treatment). (corresponding to the data in Fig.S3)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Groups | Body weight of ten flies (mg) | Body glucose content (μg/μg pro) | Hemolymph glucose content (μg/μg pro) | Total triglyceride content (μg/μg pro) |
| ND | 10.94±0.84 | 0.11±0.02 | 0.60±0.03 | 0.21±0.02 |
| 20%HSD | 10.02±0.46 | 0.26±0.04\*\*\* | 0.84±0.09\*\*\* | 1.10±0.29\*\*\* |
| 30%HSD | 9.83±0.31\* | 0.36±0.02\*\*\* | 1.13±0.15\*\*\* | 1.31±0.27\*\*\* |

Significance is marked as \* p < 0.05, \*\* p < 0.01 and \*\* p < 0.001 compared to the normal diet (ND) control.

**Table G.** α-Amylase and α-glucosidase activity and the mRNA expression change of *Amy* and *Mal-5b* genes of flies fed on a high-sugar diet from egg-stage (HSD-E treatment). (corresponding to the data in Fig.S4)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Groups | α-Amylase activity (U/mg pro) | α-Glucosidase activity (U/mg pro) | Fold change of *Amy* mRNA expression | Fold change of *Mal* mRNA expression |
| ND | 0.43±0.09 | 0.82±0.04 | 1.00±0.05 | 1.00±0.04 |
| 20%HSD | 0.49±0.10 | 0.89±0.04 | 1.10±0.31 | 1.06±0.22 |
| 30%HSD | 0.52±0.07\* | 1.02±0.09\* | 1.09±0.33 | 1.59±0.11\*\* |

Significance is marked as \* p < 0.05 and \*\* p < 0.01 compared to the ND control, and ## p < 0.01 between two HSD groups.

**Table H.** mRNA expression of main genes related to glucose and lipid metabolism in flies fed on a high-sugar diet from egg-stage (HSD-E treatment). (corresponding to the data in Fig.S5)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Groups | *dilp2* | *dilp3* | *InR* | *PEPCK* | *dAKT* | *ACC* | *dTOR* | *dFOXO* | *FAS* | *LSD* | *SREBP* | *E78* |
| ND | 1.02±0.20 | 1.01±0.19 | 1.00±0.10 | 1.01±0.13 | 1.01±0.18 | 1.01±0.13 | 1.02±0.24 | 1.00±0.08 | 1.02±0.25 | 1.01±0.15 | 1.01±0.15 | 1.01±0.18 |
| 20%HSD | 1.42±0.21\* | 3.92±1.33\* | 1.05±0.15 | 2.12±0.55 | 1.41±0.18\*\* | 0.70±0.24 | 0.98±0.24 | 0.84±0.17 | 1.33±0.16 | 1.07±0.30 | 1.37±0.30 | 1.03±0.25 |
| 30%HSD | 1.93±0.28\*\* | 4.35±0.36\*\*\* | 3.31±0.07\*\* | 3.66±0.49\*\* | 1.95±0.46\*\* | 0.06±0.04\*\*\* | 1.61±0.10\* | 0.75±0.03 | 1.47±0.13\* | 2.87±0.96\* | 1.52±0.18\* | 1.59±0.05\* |

Significance is marked as \* p < 0.05, \*\* p < 0.01 and \*\* p < 0.001 compared to the normal-diet (ND) control group.