**Effect of black soldier fly (*Hermetia illucens*) larvae meal on lipid and glucose metabolism of Pacific white shrimp *Litopenaeus vannamei***

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Fig. S1. The score plots of orthogonal partial least squares discriminant analysis (OPLS-DA) of the muscle metabolic profiles and the permutation tests of the models (n = 200). A & A1 for ESI+ and C & C1 for ESI- in BSF20 vs FM. B & B1 for ESI+ and D & D1 for ESI- in BSF30 vs FM.

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| Table S1. Differential metabolites identified in the BSF20 vs FM. |  |  |  |  |  |
| **Name** | **VIP** | **Fold change** | ***P* value** | **m/z** | **rt(s)** |
| ESI+ |  |  |  |  |  |
| n-Propyl cinnamate | 2.00 | 3.04 | 0.00 | 208.13 | 189.55 |
| L-Saccharopine | 3.07 | 0.37 | 0.00 | 277.14 | 438.80 |
| alpha-D-Glucose 1-phosphate | 1.40 | 0.39 | 0.00 | 243.03 | 493.20 |
| Glutathione | 5.09 | 0.38 | 0.00 | 308.09 | 390.32 |
| Cysteinylglycine | 1.71 | 0.39 | 0.00 | 179.05 | 390.28 |
| 1-O-Octadecyl-sn-glyceryl-3-phosphorylcholine | 2.50 | 1.62 | 0.00 | 510.39 | 189.37 |
| L-Leucine | 3.78 | 0.17 | 0.00 | 132.10 | 343.86 |
| Quinone | 2.25 | 0.42 | 0.00 | 109.03 | 462.10 |
| Hypoxanthine | 5.19 | 4.92 | 0.00 | 137.04 | 253.89 |
| D-glucosamine 6-phosphate | 1.37 | 0.35 | 0.00 | 242.04 | 459.29 |
| L-Threonine | 1.67 | 0.55 | 0.00 | 120.06 | 340.29 |
| Argininosuccinic acid | 3.05 | 3.95 | 0.00 | 291.13 | 487.66 |
| N6,N6,N6-Trimethyl-L-lysine | 3.37 | 3.39 | 0.00 | 189.16 | 581.83 |
| N-(omega)-Hydroxyarginine | 4.88 | 2.30 | 0.00 | 173.10 | 401.96 |
| (3-Carboxypropyl)trimethylammonium cation | 11.14 | 0.49 | 0.00 | 146.12 | 369.38 |
| Betaine aldehyde | 6.71 | 3.06 | 0.00 | 162.11 | 295.12 |
| Dopamine | 5.55 | 0.45 | 0.00 | 136.07 | 291.30 |
| Pro-Val | 1.70 | 0.71 | 0.00 | 215.14 | 280.64 |
| trans-2-Hydroxycinnamic acid | 4.00 | 0.59 | 0.00 | 165.05 | 291.24 |
| L-Tyrosine | 5.13 | 0.74 | 0.00 | 182.08 | 290.07 |
| Isomaltose | 13.77 | 0.59 | 0.00 | 360.15 | 389.67 |
| Tyr-Pro | 1.22 | 1.31 | 0.00 | 345.07 | 365.13 |
| L-Palmitoylcarnitine | 3.63 | 1.95 | 0.00 | 400.34 | 168.37 |
| Thr-Arg | 1.02 | 0.66 | 0.00 | 276.17 | 396.33 |
| Val-Arg | 1.28 | 0.67 | 0.00 | 274.19 | 351.65 |
| Triethanolamine | 2.03 | 0.72 | 0.00 | 213.12 | 410.12 |
| His-Ile | 3.92 | 0.64 | 0.00 | 269.16 | 286.05 |
| Eicosapentaenoic acid | 1.69 | 1.29 | 0.00 | 285.22 | 32.00 |
| Glycerophosphocholine | 16.39 | 0.66 | 0.00 | 258.11 | 377.91 |
| D-Glucose 6-phosphate | 2.56 | 0.48 | 0.01 | 261.04 | 462.45 |
| Choline | 2.23 | 0.76 | 0.01 | 104.11 | 377.83 |
| Astaxanthin | 2.59 | 1.75 | 0.01 | 597.39 | 33.99 |
| Phenyllactic acid | 1.11 | 0.72 | 0.01 | 149.06 | 248.58 |
| Arg-Met | 2.02 | 0.73 | 0.01 | 306.16 | 356.37 |
| Ile-Leu | 1.35 | 0.63 | 0.01 | 245.18 | 177.03 |
| ADP-ribose | 2.60 | 1.68 | 0.01 | 560.08 | 411.39 |
| PC(20:5(5Z,8Z,11Z,14Z,17Z)/20:5(5Z,8Z,11Z,14Z,17Z)) | 4.19 | 0.74 | 0.01 | 826.54 | 139.00 |
| Atrolactic acid | 1.18 | 0.62 | 0.02 | 131.05 | 248.60 |
| 2-Methylbutyroylcarnitine | 2.41 | 1.61 | 0.02 | 246.17 | 233.53 |
| Pyruvaldehyde | 2.07 | 0.60 | 0.02 | 145.05 | 389.67 |
| L-Arginine | 4.32 | 1.26 | 0.03 | 175.12 | 385.51 |
| Arg-Ser | 1.47 | 0.76 | 0.03 | 262.15 | 429.61 |
| D-Mannose | 1.16 | 0.63 | 0.03 | 198.10 | 389.69 |
| NG,NG-dimethyl-L-arginine(ADMA) | 1.67 | 0.69 | 0.03 | 203.15 | 485.40 |
| S-Adenosylmethionine | 1.85 | 0.62 | 0.03 | 399.14 | 462.86 |
| DL-Indole-3-lactic acid | 2.00 | 0.76 | 0.04 | 188.07 | 250.50 |
| Uracil | 1.00 | 0.74 | 0.04 | 113.03 | 154.12 |
| Pro-Ala | 1.23 | 0.62 | 0.04 | 187.11 | 328.11 |
| 3-Methylhistidine | 1.27 | 0.83 | 0.04 | 170.09 | 485.70 |
| ESI- |  |  |  |  |  |
| 1-Palmitoyl-2-oleoyl-sn-glycero-3-phosphate | 2.88 | 9.21 | 0.00 | 673.48 | 33.38 |
| Cytidine 5'-monophosphate (CMP) | 2.05 | 2.37 | 0.00 | 322.04 | 426.10 |
| m-Chlorohippuric acid | 2.76 | 1.86 | 0.00 | 213.02 | 162.68 |
| D-Erythrose 4-phosphate | 13.65 | 0.34 | 0.00 | 259.02 | 444.65 |
| D-Aspartic acid | 2.27 | 0.48 | 0.00 | 132.03 | 392.35 |
| Phosphoenolpyruvate | 2.84 | 0.45 | 0.00 | 226.99 | 403.90 |
| Acamprosate | 4.00 | 2.04 | 0.00 | 180.03 | 140.01 |
| Hydroxyphenyllactic acid | 1.59 | 0.41 | 0.00 | 181.05 | 180.56 |
| Succinate | 4.83 | 2.30 | 0.00 | 117.02 | 377.75 |
| DL-2-Aminoadipic acid | 1.43 | 0.63 | 0.00 | 160.06 | 398.44 |
| D-gluconate | 1.92 | 0.50 | 0.00 | 195.05 | 363.21 |
| sn-Glycerol 3-phosphoethanolamine | 1.25 | 0.49 | 0.00 | 214.05 | 412.80 |
| alpha-D-Galactose 1-phosphate | 1.94 | 0.34 | 0.00 | 241.01 | 445.93 |
| L-Sorbose | 4.15 | 0.52 | 0.00 | 179.05 | 389.81 |
| O-Phosphoethanolamine | 1.17 | 0.63 | 0.00 | 140.01 | 385.92 |
| Histamine | 1.96 | 0.66 | 0.00 | 110.07 | 368.67 |
| Trehalose | 36.31 | 0.59 | 0.00 | 341.11 | 389.82 |
| 3-Phosphoserine | 1.13 | 0.57 | 0.00 | 244.02 | 435.80 |
| L-Tyrosine | 7.82 | 0.61 | 0.00 | 180.07 | 292.96 |
| Dihydroxyacetone phosphate | 1.04 | 0.77 | 0.00 | 229.01 | 463.39 |
| L-Phenylalanine | 6.86 | 0.67 | 0.00 | 164.07 | 249.15 |
| Galactinol | 28.27 | 0.59 | 0.01 | 401.13 | 389.82 |
| ADP-ribose | 2.46 | 1.79 | 0.01 | 558.06 | 411.71 |
| Palmitic acid | 1.92 | 1.32 | 0.01 | 255.23 | 96.88 |
| L-Valine | 6.45 | 0.56 | 0.01 | 116.07 | 290.52 |
| Citrate | 3.38 | 0.71 | 0.01 | 191.02 | 577.57 |
| gamma-L-Glutamyl-L-valine | 1.39 | 0.62 | 0.01 | 245.11 | 367.26 |
| trans-2-Hydroxycinnamic acid | 1.55 | 0.68 | 0.01 | 163.04 | 293.12 |
| Dihydrouracil | 2.86 | 0.71 | 0.01 | 113.04 | 366.00 |
| DL-lactate | 6.95 | 0.84 | 0.02 | 89.02 | 218.73 |
| Hydroxyisocaproic acid | 3.12 | 0.76 | 0.02 | 131.07 | 127.98 |
| Xanthosine | 1.13 | 0.64 | 0.03 | 283.07 | 209.83 |
| L-Glutamine | 3.25 | 0.77 | 0.03 | 145.06 | 391.08 |
| alpha-ketoglutarate | 1.32 | 0.69 | 0.03 | 145.01 | 358.54 |
| L-Pyroglutamic acid | 3.12 | 0.73 | 0.03 | 128.03 | 362.85 |
| L-Lysine | 2.67 | 0.81 | 0.04 | 145.10 | 515.38 |
| 3-Aminopropanesulphonic Acid | 5.04 | 1.41 | 0.04 | 138.02 | 257.46 |
| Dihydrothymine | 6.26 | 0.72 | 0.04 | 127.05 | 362.85 |
| Confertifoline | 2.16 | 1.47 | 0.04 | 233.15 | 140.26 |

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| Table S2. Differential metabolites identified in the BSF30 vs FM. |  |  |  |  |  |
| **Name** | **VIP** | **Fold change** | ***P* value** | **m/z** | **rt(s)** |
| ESI+ |  |  |  |  |  |
| L-Palmitoylcarnitine | 5.03 | 3.43 | 0.00 | 400.34 | 168.37 |
| PC (20:5(5Z,8Z,11Z,14Z,17Z)/20:5(5Z,8Z,11Z,14Z,17Z)) | 6.48 | 0.48 | 0.00 | 826.54 | 139.00 |
| Phosphorylcholine | 10.65 | 0.37 | 0.00 | 184.07 | 67.82 |
| Adenylsuccinic acid | 6.25 | 0.43 | 0.00 | 464.08 | 483.79 |
| 1-O-Octadecyl-sn-glyceryl-3-phosphorylcholine | 1.98 | 1.62 | 0.00 | 510.39 | 189.37 |
| Hypoxanthine | 4.03 | 4.42 | 0.00 | 137.04 | 253.89 |
| N6, N6, N6-Trimethyl-L-lysine | 2.84 | 3.16 | 0.00 | 189.16 | 581.83 |
| Dimethylglycine | 1.31 | 2.74 | 0.00 | 104.07 | 290.93 |
| 2-Methylbutyroylcarnitine | 3.12 | 2.48 | 0.00 | 246.17 | 233.53 |
| Maltotriose | 1.00 | 0.55 | 0.00 | 522.20 | 443.57 |
| 1-Myristoyl-sn-glycero-3-phosphocholine | 1.08 | 1.69 | 0.00 | 468.31 | 193.09 |
| alpha-D-Glucose 1-phosphate | 1.03 | 0.57 | 0.00 | 243.03 | 493.20 |
| Argininosuccinic acid | 1.47 | 2.05 | 0.00 | 291.13 | 487.66 |
| 1-Oleoyl-sn-glycero-3-phosphocholine | 5.18 | 1.45 | 0.00 | 522.35 | 186.13 |
| Sphingomyelin (d18:1/18:0) | 3.05 | 2.00 | 0.00 | 731.60 | 172.81 |
| Decanoyl-L-carnitine | 1.20 | 2.25 | 0.00 | 316.25 | 186.20 |
| L-Threonine | 1.40 | 0.66 | 0.00 | 120.06 | 340.29 |
| Pantothenate | 1.52 | 2.04 | 0.00 | 220.12 | 265.20 |
| ADP-ribose | 2.11 | 1.80 | 0.00 | 560.08 | 411.39 |
| Astaxanthin | 2.69 | 2.13 | 0.01 | 597.39 | 33.99 |
| Cysteinylglycine | 1.21 | 0.64 | 0.01 | 179.05 | 390.28 |
| L-Carnitine | 3.48 | 0.60 | 0.01 | 162.11 | 344.88 |
| Glutathione | 3.38 | 0.66 | 0.02 | 308.09 | 390.32 |
| (3-Carboxypropyl) trimethylammonium cation | 8.61 | 0.65 | 0.02 | 146.12 | 369.38 |
| N-(omega)-Hydroxyarginine | 1.93 | 0.59 | 0.02 | 173.10 | 401.96 |
| Dimethyl sulfone | 1.10 | 1.19 | 0.02 | 226.99 | 345.50 |
| D-Proline | 2.24 | 1.27 | 0.02 | 116.07 | 529.10 |
| Pro-Gly | 1.83 | 0.69 | 0.03 | 173.09 | 339.80 |
| Betaine aldehyde | 3.03 | 1.79 | 0.03 | 162.11 | 295.12 |
| Quinone | 1.35 | 0.70 | 0.03 | 109.03 | 462.10 |
| alpha-Linolenic acid | 3.21 | 0.71 | 0.03 | 296.26 | 36.81 |
| Oleic acid | 1.99 | 0.87 | 0.04 | 247.24 | 35.35 |
| Arg-Ser | 1.43 | 1.27 | 0.05 | 262.15 | 429.61 |
| ESI- |  |  |  |  |  |
| (S)-2-Hydroxyglutarate | 1.07 | 3.56 | 0.00 | 147.03 | 293.06 |
| 1-Palmitoyl-2-oleoyl-sn-glycero-3-phosphate | 3.13 | 9.45 | 0.00 | 673.48 | 33.38 |
| 1-Deoxy-D-xylulose 5-phosphate | 2.84 | 2.51 | 0.00 | 235.00 | 452.25 |
| Acamprosate | 7.76 | 4.29 | 0.00 | 180.03 | 140.01 |
| Homogentisic acid | 1.07 | 0.45 | 0.00 | 167.03 | 108.83 |
| Uridine diphosphate glucose (UDP-D-Glucose) | 3.50 | 4.00 | 0.00 | 565.04 | 434.56 |
| D-Aspartic acid | 2.75 | 0.48 | 0.00 | 132.03 | 392.35 |
| D-Erythrose 4-phosphate | 13.19 | 0.54 | 0.00 | 259.02 | 444.65 |
| ADP-ribose | 3.01 | 2.00 | 0.00 | 558.06 | 411.71 |
| alpha-ketoglutarate | 2.35 | 0.52 | 0.00 | 145.01 | 358.54 |
| 3-Aminopropanesulphonic Acid | 10.86 | 2.50 | 0.00 | 138.02 | 257.46 |
| Phosphoenolpyruvate | 3.11 | 0.55 | 0.00 | 226.99 | 403.90 |
| Raffinose | 1.65 | 0.57 | 0.00 | 503.16 | 443.36 |
| N-Acetyl-D-Glucosamine 6-Phosphate | 2.91 | 1.72 | 0.00 | 300.05 | 437.05 |
| Uridine 5'-diphosphate (UDP) | 2.45 | 1.98 | 0.00 | 402.99 | 435.18 |
| Hydroxyproline | 6.79 | 0.47 | 0.00 | 130.05 | 335.56 |
| PS(16:0/16:0) | 3.73 | 0.56 | 0.01 | 734.51 | 59.66 |
| PGF3a | 1.77 | 1.41 | 0.01 | 351.21 | 168.76 |
| Pantothenate | 8.75 | 1.79 | 0.02 | 218.10 | 265.04 |
| L-Malic acid | 3.26 | 0.56 | 0.03 | 133.01 | 412.89 |
| 2-Oxoadipic acid | 14.05 | 1.44 | 0.04 | 141.02 | 346.08 |
| L-Ascorbic acid | 1.08 | 0.65 | 0.04 | 197.01 | 124.92 |
| Succinate | 2.39 | 1.42 | 0.04 | 117.02 | 377.75 |
| alpha-D-Galactose 1-phosphate | 1.47 | 0.61 | 0.05 | 241.01 | 445.93 |



Fig. S2. (A) Venn diagrams demonstrated the differential metabolites of *Litopenaeus vannamei* between BSF20 vs FM and BSF30 vs FM. (B) KEGG pathway analysis of differentially metabolites among FM, BSF20 and BSF30. Advanced bubble chart shows enrichment of differentially metabolites in signaling pathways. Y-axis label represents pathway, and X-axis label represents rich factor (rich factor = amount of differentially metabolites enriched in the pathway). Size and color of the bubble represent amount of differentially metabolites enriched in pathway and enrichment significance.