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**Table S1** Characteristics of gene-specific primers used for qPCR analysis

| Gene symbol | Forward (5` to 3`), Reverse (5` to 3`) | PCR product size (bp) | NCBI GenBank accession no. |
|---|---|---|---|
| *Reference genes* | | | |
| *Actb* | GACCTCTATGCCAACACAGT, CACCAATCCACACAGAGTAC | 154 | NM_031144 |
| *Rpl13* | CCAGATGCAGATCTGAAGAC, CTGGGTCCTCAATTTCACGT | 175 | NM_172008 |
| *Top1* | GAAGAACGCTATCCAGAAGG, GCTTTGGGACTCAGCTTCAT | 137 | NM_022615 |
| *Target genes* | | | |
| *Acadm* | CAAGAGAGCCTGGGAACTTG, CCCCAAAGAATTTGCTTCAA | 154 | NM_016986 |
| *Acox1* | CTCAGCAGGAGAAATGGATGCG, TCCTTGAGTGATGAGCTGAGCC | 239 | NM_017340 |
| *Cact* | AGCCCACCTGTTATCCACTG, TGTGCAAAAAGAGCCTTCCT | 178 | NM_053965 |
| *Cpt1a* | ACCGCCATCTCTTCTGCCTC, CTGCTGAGGAGTCTGGCTCG | 116 | NM_031559 |
| *Fasn* | AGGTGCTAGAGGCCCTGCTA, GTGCACAGACACCTTCCCAT | 281 | NM_017332 |
| *G6pd* | TTGTACCAGGGTGATGCCTTCC, GCTCACTCTGTTTGCGGATGTC | 199 | NM_017006 |
| *Hmgcr* | TGGCAGGACGCAACCTCTAC, GGCAGCAGGTTTCTTGTCGG | 173 | NM_013134 |
| *Scd* | TGCACCCCCAGACACTTGTAA, GGATGCATGGAAACGCCATAG | 94 | NM_031841 |

Abbreviations: Acadm, acyl-CoA dehydrogenase medium chain; Acox1, acyl-CoA oxidase 1; Actb, actin beta; Cact, carnitine/acylcarnitine translocase; Cpt1a, carnitine palmitoyltransferase 1A; Fasn, fatty acid synthase; G6pd, glucose-6-phosphate dehydrogenase; Hmgcr, 3-hydroxy-3-methylglutaryl-CoA reductase; Rpl13, ribosomal protein L13; Scd, stearoyl-CoA desaturase; Top1, DNA topoisomerase I.

**Table S2** Operational taxonomic units (OUT) identified in cecum digesta of all experimental groups

| OTU | Phylum | Class | Order | Family | Genus |
|---|---|---|---|---|---|
| OTU_1 | Firmicutes | Clostridia | Clostridiales | Clostridiaceae 1 | Clostridium sensu stricto |
| OTU_2 | Verrucomicrobia | Verrucomicrobiae | Verrucomicrobiales | Verrucomicrobiaceae | Akkermansia |
| OTU_3 | Firmicutes | Clostridia | Clostridiales | - | - |
| OTU_4 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_5 | Bacteroidetes | Bacteroidia | Bacteroidales | Bacteroidaceae | Bacteroides |
| OTU_6 | Firmicutes | Erysipelotrichia | Erysipelotrichales | Erysipelotrichaceae | Allobaculum |
| OTU_7 | Bacteroidetes | Bacteroidia | Bacteroidales | Bacteroidaceae | Bacteroides |
| OTU_8 | Bacteroidetes | Bacteroidia | Bacteroidales | Bacteroidaceae | Bacteroides |
| OTU_9 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_10 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | Ruminococcus |
| OTU_11 | Firmicutes | Bacilli | Lactobacillales | Lactobacillaceae | Lactobacillus |
| OTU_12 | Firmicutes | Bacilli | Lactobacillales | Lactobacillaceae | Lactobacillus |
| OTU_13 | Bacteroidetes | Bacteroidia | Bacteroidales | Bacteroidaceae | Bacteroides |
| OTU_14 | Bacteroidetes | Bacteroidia | Bacteroidales | Prevotellaceae | Alloprevotella |
| OTU_15 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | - |
| OTU_16 | Firmicutes | Clostridia | Clostridiales | Peptostreptococcaceae | Clostridium XI |
| OTU_17 | Bacteroidetes | Bacteroidia | Bacteroidales | Bacteroidaceae | Bacteroides |
| OTU_18 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | Clostridium XlVa |

| | | | | | |
|---|---|---|---|---|---|
| OTU_19 | Bacteroidetes | Bacteroidia | Bacteroidales | Rikenellaceae | Alistipes |
| OTU_20 | Deferribacteres | Deferribacteres | Deferribacterales | Deferribacteraceae | Mucispirillum |
| OTU_21 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | - |
| OTU_22 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_23 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | - |
| OTU_24 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | - |
| OTU_25 | Firmicutes | Clostridia | Clostridiales | Clostridiaceae 1 | Clostridium sensu stricto |
| OTU_26 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_27 | Bacteroidetes | Bacteroidia | Bacteroidales | Porphyromonadaceae | Parabacteroides |
| OTU_28 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | Oscillibacter |
| OTU_29 | Firmicutes | Clostridia | Clostridiales | Clostridiaceae 1 | Clostridium sensu stricto |
| OTU_30 | Firmicutes | Clostridia | Clostridiales | Peptostreptococcaceae | Clostridium XI |
| OTU_31 | Bacteroidetes | Bacteroidia | Bacteroidales | Porphyromonadaceae | Parabacteroides |
| OTU_32 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | Clostridium XlVa |
| OTU_33 | Firmicutes | Erysipelotrichia | Erysipelotrichales | Erysipelotrichaceae | Turicibacter |
| OTU_34 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | Flavonifractor |
| OTU_35 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_36 | Bacteroidetes | Bacteroidia | Bacteroidales | Porphyromonadaceae | - |
| OTU_37 | Bacteroidetes | Bacteroidia | Bacteroidales | Porphyromonadaceae | - |
| OTU_38 | Bacteroidetes | Bacteroidia | Bacteroidales | Porphyromonadaceae | - |

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|---|---|---|---|---|---|
| OTU_39 | Proteobacteria | Alphaproteobacteria | - | - | - |
| OTU_40 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_41 | Bacteroidetes | Bacteroidia | Bacteroidales | Rikenellaceae | Alistipes |
| OTU_42 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | - |
| OTU_43 | Firmicutes | Bacilli | Lactobacillales | Lactobacillaceae | Lactobacillus |
| OTU_44 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | Ruminococcus |
| OTU_45 | Proteobacteria | Deltaproteobacteria | Desulfovibrionales | Desulfovibrionaceae | Desulfovibrio |
| OTU_46 | Bacteroidetes | Bacteroidia | Bacteroidales | - | - |
| OTU_47 | Proteobacteria | Gammaproteobacteria | Enterobacteriales | Enterobacteriaceae | Escherichia/Shigella |
| OTU_48 | Firmicutes | Clostridia | Clostridiales | - | - |
| OTU_49 | Proteobacteria | Deltaproteobacteria | Desulfovibrionales | Desulfovibrionaceae | Bilophila |
| OTU_50 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | Coprococcus |
| OTU_51 | Bacteroidetes | Bacteroidia | Bacteroidales | Porphyromonadaceae | - |
| OTU_52 | Bacteroidetes | Bacteroidia | Bacteroidales | Bacteroidaceae | Bacteroides |
| OTU_53 | Firmicutes | Negativicutes | Selenomonadales | Acidaminococcaceae | Phascolarctobacterium |
| OTU_54 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_55 | Bacteroidetes | Bacteroidia | Bacteroidales | Rikenellaceae | Alistipes |
| OTU_56 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_57 | Proteobacteria | Deltaproteobacteria | Desulfovibrionales | Desulfovibrionaceae | Desulfovibrio |
| OTU_58 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |

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|---|---|---|---|---|---|
| OTU_59 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | - |
| OTU_60 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | Clostridium XlVb |
| OTU_61 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | - |
| OTU_62 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | Roseburia |
| OTU_63 | Firmicutes | Clostridia | Clostridiales | Peptococcaceae 1 | Peptococcus |
| OTU_64 | Bacteroidetes | Bacteroidia | Bacteroidales | Porphyromonadaceae | Parabacteroides |
| OTU_65 | Firmicutes | Clostridia | Clostridiales | - | - |
| OTU_66 | Bacteroidetes | Bacteroidia | Bacteroidales | Porphyromonadaceae | - |
| OTU_67 | Bacteroidetes | Bacteroidia | Bacteroidales | Rikenellaceae | Alistipes |
| OTU_68 | Firmicutes | Clostridia | Clostridiales | Eubacteriaceae | Eubacterium |
| OTU_69 | Tenericutes | Mollicutes | Anaeroplasmatales | Anaeroplasmataceae | Anaeroplasma |
| OTU_70 | Bacteroidetes | Bacteroidia | Bacteroidales | - | - |
| OTU_71 | Bacteroidetes | Bacteroidia | Bacteroidales | Porphyromonadaceae | Odoribacter |
| OTU_72 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | - |
| OTU_73 | Bacteroidetes | Bacteroidia | Bacteroidales | Porphyromonadaceae | - |
| OTU_74 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_75 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | - |
| OTU_76 | Bacteroidetes | Bacteroidia | Bacteroidales | Porphyromonadaceae | - |
| OTU_77 | Proteobacteria | Alphaproteobacteria | - | - | - |
| OTU_78 | Actinobacteria | Actinobacteria | Bifidobacteriales | Bifidobacteriaceae | Bifidobacterium |

| | | | | | |
|---|---|---|---|---|---|
| OTU_79 | Firmicutes | Erysipelotrichia | Erysipelotrichales | Erysipelotrichaceae | Clostridium XVIII |
| OTU_80 | Bacteroidetes | Bacteroidia | Bacteroidales | Porphyromonadaceae | - |
| OTU_81 | Firmicutes | Clostridia | Clostridiales | - | - |
| OTU_83 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | - |
| OTU_84 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | Clostridium IV |
| OTU_85 | Firmicutes | Clostridia | Clostridiales | Peptostreptococcaceae | Clostridium XI |
| OTU_86 | Bacteroidetes | Bacteroidia | Bacteroidales | Porphyromonadaceae | Butyricimonas |
| OTU_87 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_88 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_90 | Bacteroidetes | Bacteroidia | Bacteroidales | Porphyromonadaceae | - |
| OTU_92 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | - |
| OTU_94 | Proteobacteria | Betaproteobacteria | Burkholderiales | Sutterellaceae | Parasutterella |
| OTU_95 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_97 | Firmicutes | Clostridia | Clostridiales | - | - |
| OTU_98 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_99 | Proteobacteria | Deltaproteobacteria | - | - | - |
| OTU_100 | Firmicutes | Clostridia | Clostridiales | - | - |
| OTU_102 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_104 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_106 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | Clostridium XlVb |

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|---|---|---|---|---|---|
| OTU_107 | Bacteroidetes | Bacteroidia | Bacteroidales | Bacteroidaceae | Bacteroides |
| OTU_109 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | Lachnospiracea_incertae_sedis |
| OTU_111 | Proteobacteria | Alphaproteobacteria | - | - | - |
| OTU_112 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_113 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | Clostridium IV |
| OTU_114 | Firmicutes | Erysipelotrichia | Erysipelotrichales | Erysipelotrichaceae | - |
| OTU_115 | Proteobacteria | Alphaproteobacteria | - | - | - |
| OTU_116 | Bacteroidetes | Bacteroidia | Bacteroidales | Porphyromonadaceae | Odoribacter |
| OTU_117 | Bacteroidetes | Bacteroidia | Bacteroidales | Porphyromonadaceae | Butyricimonas |
| OTU_118 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_119 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_121 | Actinobacteria | Actinobacteria | Coriobacteriales | Coriobacteriaceae | Olsenella |
| OTU_124 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | Clostridium XlVa |
| OTU_125 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | Blautia |
| OTU_127 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_128 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | - |
| OTU_130 | Bacteroidetes | Bacteroidia | Bacteroidales | Porphyromonadaceae | - |
| OTU_132 | Bacteroidetes | Bacteroidia | Bacteroidales | Porphyromonadaceae | Barnesiella |
| OTU_133 | Bacteroidetes | Bacteroidia | Bacteroidales | Porphyromonadaceae | Parabacteroides |
| OTU_135 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | - |

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|---|---|---|---|---|---|
| OTU_139 | Firmicutes | Erysipelotrichia | Erysipelotrichales | Erysipelotrichaceae | - |
| OTU_140 | - | - | - | - | - |
| OTU_146 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | - |
| OTU_153 | Bacteroidetes | - | - | - | - |
| OTU_154 | Firmicutes | Bacilli | Bacillales | - | - |
| OTU_159 | Firmicutes | - | - | - | - |
| OTU_160 | Bacteroidetes | Bacteroidia | Bacteroidales | Rikenellaceae | Alistipes |
| OTU_166 | Firmicutes | Clostridia | Clostridiales | Clostridiaceae 1 | Clostridium sensu stricto |
| OTU_167 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_168 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_174 | Bacteroidetes | Bacteroidia | Bacteroidales | Bacteroidaceae | Bacteroides |
| OTU_176 | Firmicutes | Erysipelotrichia | Erysipelotrichales | Erysipelotrichaceae | Allobaculum |
| OTU_180 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_187 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_194 | Firmicutes | Erysipelotrichia | Erysipelotrichales | Erysipelotrichaceae | Allobaculum |
| OTU_197 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | Clostridium XlVa |
| OTU_202 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_206 | Candidatus Saccharibacteria | Saccharibacteria_genera_incertae_sedis | Saccharibacteria_genera_incertae_sedis | Saccharibacteria_genera_incertae_sedis | Saccharibacteria_genera_incertae_sedis |
| OTU_212 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |

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|---|---|---|---|---|---|
| OTU_274 | Bacteroidetes | Bacteroidia | Bacteroidales | Bacteroidaceae | Bacteroides |
| OTU_315 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_516 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | Ruminococcus |
| OTU_531 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | - |
| OTU_535 | Firmicutes | Clostridia | Clostridiales | Clostridiaceae 1 | - |
| OTU_537 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_544 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_554 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | - |
| OTU_580 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_632 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | Blautia |
| OTU_662 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |
| OTU_692 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | - |
| OTU_701 | Firmicutes | Bacilli | Lactobacillales | Lactobacillaceae | Lactobacillus |
| OTU_703 | Firmicutes | Clostridia | Clostridiales | Ruminococcaceae | - |
| OTU_729 | Firmicutes | Clostridia | Clostridiales | Lachnospiraceae | - |

**Table S3** Concentrations of plasma metabolites with statistical differences as identified by targeted plasma metabolomics of lean rats fed a nutrient-adequate basal diet (group L) and obese rats fed the same basal diet supplemented with 0% (O), 1.5% (group O1.5) and 3.0% insects' cuticles (group O3.0) for 4 weeks

| | | L | O | O1.5 | O3.0 | *p*-value | |
|---|---|---|---|---|---|---|---|
| Metabolite class | Metabolite | | | | | L vs. O | Suppl* |
| | | | | *µmol/L* | | | |
| Acylcarnitines | Free carnitine | 42.8 ± 6.2 | 32.3 ± 6.2$^{a}$ | 35.9 ± 5.6$^{a}$ | 28.6 ± 5.4$^{b}$ | 0.001 | 0.029 |
| Acylcarnitines | Butyrylcarnitine | 1.94 ± 0.42 | 2.31 ± 0.30$^{b}$ | 2.52 ± 0.50$^{ab}$ | 2.98 ± 0.75$^{a}$ | 0.042 | 0.030 |
| Amine oxides | Trimethylamine *N*-oxide | 1.01 ± 0.22 | 1.26 ± 0.28$^{b}$ | 1.33 ± 0.19$^{b}$ | 1.65 ± 0.25$^{a}$ | 0.041 | 0.003 |
| Amino acids | Asparagine | 89.4 ± 14.3 | 81.2 ± 11.0$^{a}$ | 80.5 ± 9.3$^{a}$ | 66.0 ± 11.7$^{b}$ | 0.166 | 0.005 |
| Amino acids | Glutamine | 928 ± 67.8 | 863 ± 111$^{a}$ | 926 ± 90$^{a}$ | 724 ± 130$^{b}$ | 0.131 | 0.001 |
| Amino acids | Glycine | 174 ± 37 | 87.8 ± 10.0$^{a}$ | 90.3 ± 10.5$^{a}$ | 75.1 ± 12.8$^{b}$ | <0.001 | 0.011 |
| Amino acids | Histidine | 65.3 ± 8.3 | 102 ± 7$^{a}$ | 101 ± 10$^{ab}$ | 89.8 ± 12.3$^{b}$ | <0.001 | 0.018 |
| Amino acids | Phenylalanine | 88.0 ± 10.8 | 116 ± 9$^{a}$ | 111 ± 11$^{ab}$ | 104 ± 10$^{b}$ | <0.001 | 0.044 |
| Amino acids | Serine | 215 ± 23 | 186 ± 20$^{a}$ | 184 ± 22$^{a}$ | 159 ± 20$^{b}$ | 0.009 | 0.011 |
| Amino acids-related | Anserine | 5.04 ± 0.69 | 3.78 ± 1.07$^{a}$ | 3.31 ± 0.74$^{ab}$ | 2.55 ± 0.96$^{b}$ | 0.006 | 0.022 |
| Amino acids-related | Proline betaine | 0.13 ± 0.02 | 0.12 ± 0.02$^{c}$ | 0.18 ± 0.02$^{b}$ | 0.21 ± 0.03$^{a}$ | 0.242 | <0.001 |
| Bile acids | DCA | 0.12 ± 0.02 | 0.18 ± 0.07$^{b}$ | 0.19 ± 0.10$^{b}$ | 0.34 ± 0.12$^{a}$ | 0.128 | 0.004 |
| Bile acids | TDCA | 0.02 ± 0.01 | 0.05 ± 0.02$^{b}$ | 0.09 ± 0.06$^{ab}$ | 0.11 ± 0.04$^{a}$ | <0.001 | 0.005 |
| Bile acids | TLCA | < LOD | 0.003 ± 0.001$^{b}$ | 0.003 ± 0.001$^{ab}$ | 0.005 ± 0.001$^{a}$ | - | 0.013 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Biogenic amines | Putrescine | 1.14 ± 0.09 | 1.21 ± 0.24$^{ab}$ | 1.37 ± 0.17$^{a}$ | 1.05 ± 0.32$^{b}$ | 0.739 | 0.033 |
| Biogenic amines | β-alanine | 4.01 ± 0.82 | 2.78 ± 0.46$^{ab}$ | 2.86 ± 0.56$^{a}$ | 2.30 ± 0.43$^{b}$ | 0.001 | 0.034 |
| Ceramides | Cer(d18:1/22:0) | 0.51 ± 0.12 | 2.62 ± 0.40$^{ab}$ | 2.89 ± 0.48$^{a}$ | 2.31 ± 0.48$^{b}$ | <0.001 | 0.028 |
| Ceramides | Cer(d18:1/24:1) | 0.74 ± 0.16 | 3.94 ± 1.28$^{ab}$ | 4.34 ± 1.03$^{a}$ | 2.95 ± 0.69$^{b}$ | <0.001 | 0.016 |
| Ceramides | Cer(d18:1/26:0) | 0.13 ± 0.04 | 0.17 ± 0.05$^{b}$ | 0.24 ± 0.05$^{a}$ | 0.17 ± 0.06$^{b}$ | 0.052 | 0.011 |
| Ceramides | Cer(d18:1/26:1) | 0.04 ± 0.01 | 0.06 ± 0.02$^{ab}$ | 0.07 ± 0.01$^{a}$ | 0.05 ± 0.01$^{b}$ | 0.002 | 0.003 |
| Ceramides | Cer(d18:1/20:0(OH)) | < LOD | 0.94 ± 0.30$^{ab}$ | 1.29 ± 0.49$^{a}$ | 0.76 ± 0.15$^{b}$ | - | 0.031 |
| Ceramides | Cer(d18:2/16:0) | < LOD | 0.06 ± 0.01$^{b}$ | 0.08 ± 0.02$^{a}$ | 0.06 ± 0.01$^{ab}$ | - | 0.036 |
| Cholesterol esters | CE(14:1) | < LOD | 0.17 ± 0.04$^{b}$ | 0.24 ± 0.07$^{a}$ | 0.18 ± 0.06$^{ab}$ | - | 0.041 |
| Cholesterol esters | CE(22:2) | 0.17 ± 0.04 | 0.42 ± 0.12$^{b}$ | 0.64 ± 0.23$^{a}$ | 0.54 ± 0.16$^{ab}$ | <0.001 | 0.043 |
| Diacylglycerols | DG(16:0_18:1) | 4.16 ± 1.63 | 6.08 ± 1.26$^{b}$ | 6.72 ± 1.25$^{ab}$ | 8.28 ± 2.27$^{a}$ | 0.009 | 0.018 |
| Glycerophospholipids | PC aa C32:0 | 10.1 ± 1.7 | 18.8 ± 3.5$^{ab}$ | 21.0 ± 3.5$^{a}$ | 15.9 ± 2.6$^{b}$ | <0.001 | 0.005 |
| Glycerophospholipids | PC aa C32:1 | 16.6 ± 5.2 | 47.6 ± 6.2$^{b}$ | 58.9 ± 8.3$^{a}$ | 44.4 ± 7.5$^{b}$ | <0.001 | <0.001 |
| Glycerophospholipids | PC aa C32:2 | 4.33 ± 1.05 | 4.89 ± 0.96$^{b}$ | 5.92 ± 0.69$^{a}$ | 5.03 ± 1.06$^{ab}$ | 0.229 | 0.038 |
| Glycerophospholipids | PC aa C34:1 | 73.6 ± 16.5 | 207 ± 27$^{b}$ | 243 ± 22$^{a}$ | 195 ± 31$^{b}$ | <0.001 | 0.001 |
| Glycerophospholipids | PC aa C34:2 | 192 ± 24 | 240 ± 34$^{ab}$ | 270 ± 28$^{a}$ | 231 ± 31$^{b}$ | 0.002 | 0.024 |
| Glycerophospholipids | PC aa C36:1 | 19.8 ± 5.4 | 92.6 ± 12.1$^{ab}$ | 106 ± 12$^{a}$ | 88.8 ± 15.7$^{b}$ | <0.001 | 0.016 |
| Glycerophospholipids | PC ae C32:1 | 0.82 ± 0.14 | 1.47 ± 0.24$^{ab}$ | 1.69 ± 0.18$^{a}$ | 1.40 ± 0.19$^{b}$ | <0.001 | <0.001 |
| Glycerophospholipids | PC ae C34:1 | 3.29 ± 0.65 | 6.28 ± 1.03$^{b}$ | 7.48 ± 0.85$^{a}$ | 5.66 ± 1.03$^{b}$ | <0.001 | <0.001 |
| Glycerophospholipids | PC ae C34:2 | 2.40 ± 0.43 | 2.36 ± 0.32$^{b}$ | 2.75 ± 0.35$^{a}$ | 2.17 ± 0.30$^{b}$ | 0.853 | 0.001 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Glycerophospholipids | PC ae C36:4 | 4.23 ± 0.74 | 6.86 ± 0.90$^{b}$ | 7.93 ± 0.82$^{a}$ | 6.30 ± 0.98$^{b}$ | <0.001 | 0.001 |
| Glycerophospholipids | PC ae C36:5 | 1.31 ± 0.24 | 2.62 ± 0.30$^{ab}$ | 2.81 ± 0.31$^{a}$ | 2.34 ± 0.32$^{b}$ | <0.001 | 0.007 |
| Glycerophospholipids | PC ae C38:5 | 3.73 ± 0.83 | 8.31 ± 1.34$^{ab}$ | 8.69 ± 0.62$^{a}$ | 7.29 ± 1.09$^{b}$ | <0.001 | 0.017 |
| Glycerophospholipids | PC ae C42:5 | < LOD | 0.81 ± 0.10$^{b}$ | 0.86 ± 0.10$^{ab}$ | 0.95 ± 0.10$^{a}$ | - | 0.025 |
| Glycerophospholipids | PC ae C44:4 | 0.14 ± 0.05 | 0.19 ± 0.03$^{b}$ | 0.23 ± 0.03$^{a}$ | 0.21 ± 0.02$^{ab}$ | 0.005 | 0.039 |
| Glycerophospholipids | lysoPC a C18:0 | 105 ± 21 | 196 ± 30$^{b}$ | 215 ± 25$^{ab}$ | 229 ± 28$^{a}$ | <0.001 | 0.044 |
| Glycosylceramides | HexCer(d18:1/18:0) | < LOD | 0.69 ± 0.23$^{ab}$ | 0.88 ± 0.35$^{a}$ | 0.56 ± 0.17$^{b}$ | - | 0.034 |
| Glycosylceramides | HexCer(d18:1/22:0) | 1.43 ± 0.36 | 6.81 ± 1.38$^{ab}$ | 7.69 ± 1.99$^{a}$ | 5.88 ± 0.96$^{b}$ | <0.001 | 0.039 |
| Glycosylceramides | HexCer(d18:1/23:0) | 0.57 ± 0.10 | 1.92 ± 0.31$^{ab}$ | 2.21 ± 0.41$^{a}$ | 1.82 ± 0.203$^{b}$ | <0.001 | 0.029 |
| Glycosylceramides | HexCer(d18:1/24:0) | 1.10 ± 0.20 | 3.19 ± 0.60$^{b}$ | 4.07 ± 0.91$^{a}$ | 2.74 ± 0.49$^{b}$ | <0.001 | <0.001 |
| Glycosylceramides | HexCer(d18:1/24:1) | 1.26 ± 0.27 | 6.72 ± 2.44$^{ab}$ | 7.77 ± 2.30$^{a}$ | 5.05 ± 1.87$^{b}$ | <0.001 | 0.034 |
| Glycosylceramides | HexCer(d18:2/24:0) | 0.25 ± 0.05 | 0.66 ± 0.12$^{b}$ | 0.84 ± 0.15$^{a}$ | 0.65 ± 0.13$^{b}$ | <0.001 | 0.020 |
| Glycosylceramides | Hex3Cer(d18:1/26:1) | < LOD | 0.34 ± 0.05$^{a}$ | 0.25 ± 0.09$^{ab}$ | 0.18 ± 0.06$^{b}$ | - | 0.009 |
| Indoles derivatives | Indole-3-propionic acid | 0.30 ± 0.09 | 0.46 ± 0.14$^{b}$ | 0.51 ± 0.18$^{b}$ | 1.05 ± 0.27$^{a}$ | 0.007 | <0.001 |
| Indoles derivatives | 3-Indoxylsulfate | 5.03 ± 1.72 | 4.27 ± 1.66$^{b}$ | 3.61 ± 0.66$^{b}$ | 5.02 ± 1.21$^{a}$ | 0.333 | 0.018 |
| Sphingolipids | SM C18:0 | 1.82 ± 0.38 | 11.7 ± 4.4$^{a}$ | 11.7 ± 3.8$^{a}$ | 7.37 ± 1.75$^{b}$ | <0.001 | 0.014 |
| Sphingolipids | SM C18:1 | 0.66 ± 0.12 | 2.10 ± 0.55$^{ab}$ | 2.18 ± 0.28$^{a}$ | 1.68 ± 0.32$^{b}$ | <0.001 | 0.022 |
| Sphingolipids | SM C26:1 | 0.20 ± 0.04 | 0.23 ± 0.07$^{ab}$ | 0.30 ± 0.13$^{a}$ | 0.14 ± 0.07$^{b}$ | 0.356 | <0.001 |
| Sphingolipids | SM (OH) C16:1 | 0.24 ± 0.06 | 0.34 ± 0.06$^{a}$ | 0.35 ± 0.06$^{a}$ | 0.26 ± 0.05$^{b}$ | 0.001 | <0.001 |

Data are means ± SD, n = 10/group. Abbreviations: aa, diacyl species; ae, acyl-alkyl species, ae, CE, cholesterylester; Cer, ceramide; DCA, deoxycholic acid; DG, diacylglycerol; HexCer, hexosylceramide; Hex3Cer; trihexosylceramide; LOD, limit of detection; lysoPC, lysophosphatidylcholine; PC, phosphatidylcholine; SM, sphingomyelin; TDCA, taurodeoxycholic acid; TLCA, taurolithocholic acid.

*Effect of supplementation with insects' cuticles within the obese groups: [a,b]Means without a common letter differ across the obese groups, $p<0.05$.