

**Table S6.** RDP classification of the sequence ratio at phylum level. Data are represented as the means  $\pm$  S.D and analysed by Mann-Whitney test. \*\*\* $P<0.001$ , \*\* $P<0.01$  and \* $P<0.05$  vs the HFD group.

Phylum	Control (%)	HFD (%)	HFD+M (%)	HFD+FO600 (%)	HFD+KO600 (%)	HFD+ FO300KO300 (%)	HFD+ FO400KO200 (%)	HFD+ FO450KO150 (%)
<i>Bacteroidetes</i>	68.44 $\pm$ 4.67 $\uparrow$ ***	33.88 $\pm$ 3.21	43.3 $\pm$ 4.22 $\uparrow$ ***	34.58 $\pm$ 4.21 $\uparrow$	53.96 $\pm$ 4.31 $\uparrow$ ***	44.11 $\pm$ 5.42 $\uparrow$ ***	40.06 $\pm$ 5.17 $\uparrow$ **	32.87 $\pm$ 4.88 $\downarrow$
<i>Firmicutes</i>	24.13 $\pm$ 2.42 $\downarrow$ ***	46.93 $\pm$ 3.34	39.68 $\pm$ 3.17 $\downarrow$ **	40.87 $\pm$ 3.47 $\downarrow$ **	38.55 $\pm$ 8.75 $\downarrow$ **	36.32 $\pm$ 3.41 $\downarrow$ **	47.23 $\pm$ 3.43 $\uparrow$	44.58 $\pm$ 5.87 $\downarrow$
<i>Proteobacteria</i>	4.76 $\pm$ 1.22 $\downarrow$ **	15.89 $\pm$ 2.33	11.56 $\pm$ 2.19 $\downarrow$ *	22.83 $\pm$ 2.21 $\uparrow$ **	4.67 $\pm$ 1.15 $\downarrow$ **	11.87 $\pm$ 2.45 $\downarrow$ **	6.9 $\pm$ 2.13 $\downarrow$ **	18.76 $\pm$ 2.16 $\uparrow$ *
<i>Actinobacteria</i>	2.17 $\pm$ 0.89 $\uparrow$	1.74 $\pm$ 0.67	4.29 $\pm$ 1.78 $\uparrow$ *	0.79 $\pm$ 0.11 $\downarrow$ **	1.25 $\pm$ 0.32 $\downarrow$	5.1 $\pm$ 1.88 $\uparrow$ *	3.65 $\pm$ $\uparrow$ *	2.32 $\pm$ 0.88 $\uparrow$
<i>Cyanobacteria/Chloroplast</i>	0.15 $\pm$ 0.04 $\downarrow$	0.3 $\pm$ 0.02	0.36 $\pm$ 0.13 $\uparrow$	0.1 $\pm$ 0.012 $\downarrow$	0.21 $\pm$ 0.05 $\downarrow$	1.09 $\pm$ 0.21 $\uparrow$ *	0.98 $\pm$ 0.12 $\uparrow$ *	0.48 $\pm$ 0.16 $\uparrow$
<i>Planctomycetes</i>	0.12 $\pm$ 0.02 $\downarrow$ *	0.22 $\pm$ 0.11	0.33 $\pm$ 0.10 $\uparrow$	0.08 $\pm$ 0.001 $\downarrow$ *	0.16 $\pm$ 0.07 $\downarrow$	0.68 $\pm$ 0.04 $\uparrow$ *	0.54 $\pm$ 0.16 $\uparrow$ *	0.22 $\pm$ 0.09
<i>Deferribacteres</i>	0.01 $\pm$ 0.001 $\downarrow$ *	0.28 $\pm$ 0.12	0.05 $\pm$ 0.01 $\downarrow$ **	0.45 $\pm$ 0.06 $\uparrow$ *	0.61 $\pm$ 0.11 $\uparrow$ *	0.18 $\pm$ 0.08 $\downarrow$	0.02 $\pm$ 0.01 $\downarrow$	0.41 $\pm$ 0.07 $\uparrow$ *
<i>Candidatus Saccharibacteria</i>	0.05 $\pm$ 0.01 $\downarrow$ **	0.46 $\pm$ 0.11	0.15 $\pm$ 0.02 $\downarrow$ **	0.15 $\pm$ 0.02 $\downarrow$ *	0.34 $\pm$ 0.08 $\downarrow$	0.05 $\pm$ 0.01 $\downarrow$ *	0.04 $\pm$ 0.01 $\downarrow$ *	0.07 $\pm$ 0.01 $\downarrow$ *
<i>Verrucomicrobia</i>	0.07 $\pm$ 0.02 $\downarrow$	0.15 $\pm$ 0.03	0.14 $\pm$ 0.01 $\downarrow$	0.04 $\pm$ 0.001 $\downarrow$ *	0.06 $\pm$ 0.01 $\downarrow$ *	0.38 $\pm$ 0.10 $\uparrow$ *	0.29 $\pm$ 0.07 $\uparrow$ *	0.14 $\pm$ 0.03 $\downarrow$
<i>Unclassified</i>	0.05 $\pm$ 0.01 $\downarrow$	0.07 $\pm$ 0.01	0.07 $\pm$ 0.02 $\downarrow$	0.08 $\pm$ 0.023 $\uparrow$	0.11 $\pm$ 0.02 $\uparrow$	0.04 $\pm$ 0.01 $\downarrow$	0.13 $\pm$ 0.04 $\uparrow$	0.08 $\pm$ 0.01 $\uparrow$