

Supporting Information

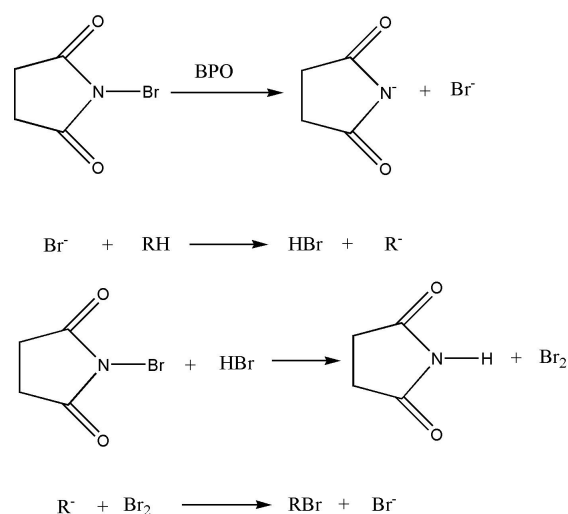


Fig. S1 The mechanism of bromine free radical reaction.

Part I: The characterization results of DAGL and DAGL.Cr

DAGL was obtained by C-N cross-coupling reaction of 6, 8-bromoluteolin boric acid complex at C6 and C8 positions and deborax protection. FT-IR (KBr cm^{-1}) (Fig. S2A): 3437.65(O-H), 1665.38(C=O), 1611.67(C=C(Ar)), 1262.87(C-N(Ar)), 1123.2(C-N), 803.51(N-H), and the wavenumber of 1262.87cm^{-1} indicated that the amino group on aminoguanidine had been connected to the C6 and C8 positions of 6, 8-bromoluteolin. Furthermore, HRMS (ESI, positive mode) calcd for $\text{C}_{17}\text{H}_{20}\text{N}_{10}\text{O}_6^+$ 461.1646, found $\text{C}_{17}\text{H}_{20}\text{N}_{10}\text{O}_6^+$ 461.1642(Fig. S2B), indicating that DAGL had been synthesized. Finally, the C5 hydroxyl group on DAGL complexed with chromium acetate, FT-IR (KBr cm^{-1}) (Fig. S3A): 3420.12(O-H), 1624.09(C=O), 1570.91(C=C(Ar)), 1256.5(C-N(Ar)), 1125.45(C-N), and 811.83(N-H). Compared with 1665.38(C=O) of DAGL, 1624.09(C=O) of DAGL.Cr was found to be red shifted and the absorption peak became weaker, owing to a coordination effect between the C4 position carbonyl group and Cr(III). As a result, DAGL.Cr moved

from 1665.38cm^{-1} to 1624.09cm^{-1} . It also indicated that oxygen in the carbonyl group participated in the coordination reaction. The electron cloud of the carbonyl group deviated from the geometric center of the bond and moved to the oxygen atom after being coordinated with Cr(III), decreasing the carbonyl group's double-bond character. Furthermore, the vibration absorption peak of the C=C(Ar) skeleton on DAGL.Cr became weaker than $1611.67(\text{C}=\text{C}(\text{Ar}))$ of DAGL and red shifted to 1570.91cm^{-1} , which showed that the formation of DAGL.Cr complex enhanced the conjugation effect of the benzene ring. Meanwhile, in Fig. S3B, the UV-vis maximum absorption wavelengths of DAGL in ethanol were 266 and 356 nm, while DAGL.Cr were 285 and 454 nm. Both the peaks of DAGL.Cr were red shifted when DAGL was complexed with chromium acetate, and this red shift was caused by the C5 hydroxyl oxygen substitution of the DAGL^[21]. Furthermore, the changes in the surface morphology of DAGL and DAGL.Cr was also observed by SEM (Fig. S3C-D). DAGL has a smooth surface, whereas the surface of DAGL.Cr had a distinct rough and complex conformation. We hypothesized that the irregular and fluffy surface morphology of DAGL.Cr is due to the complex interaction between Cr(III) and DAGL.

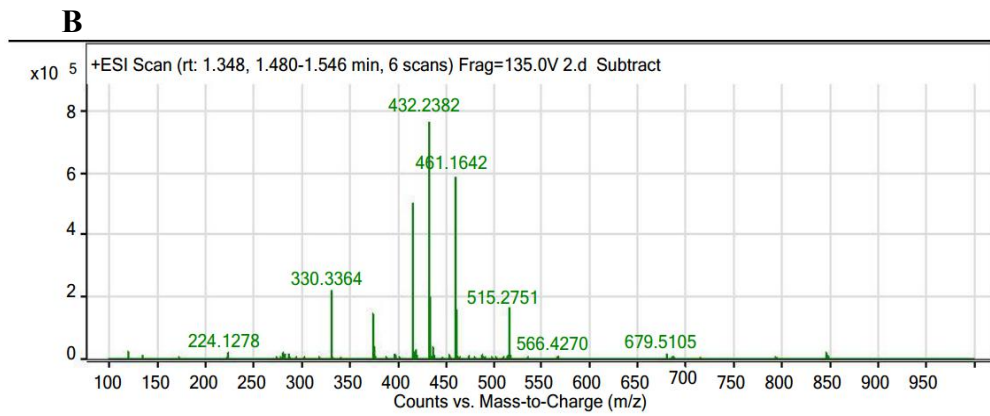
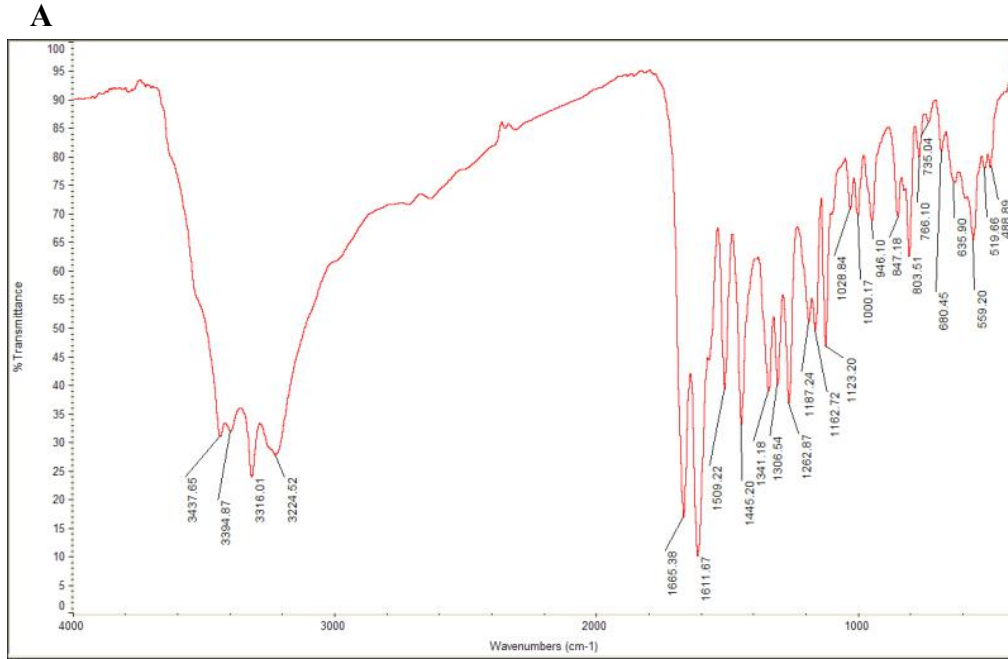
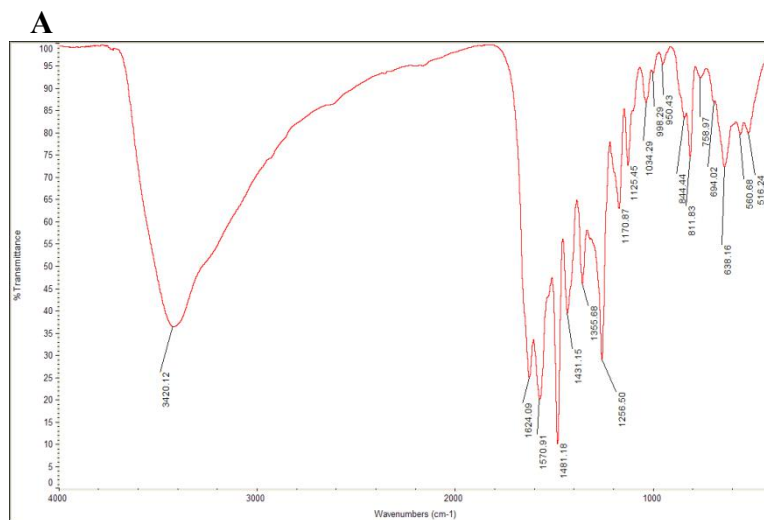


Fig. S2 The FT-IR spectra and HRMS figure of DAGL. (A) FT-IR; (B) HRMS.



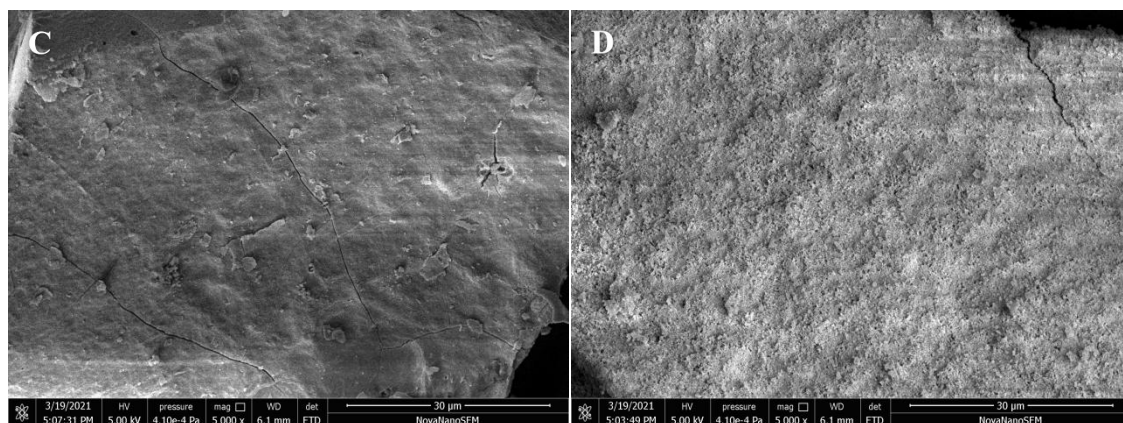
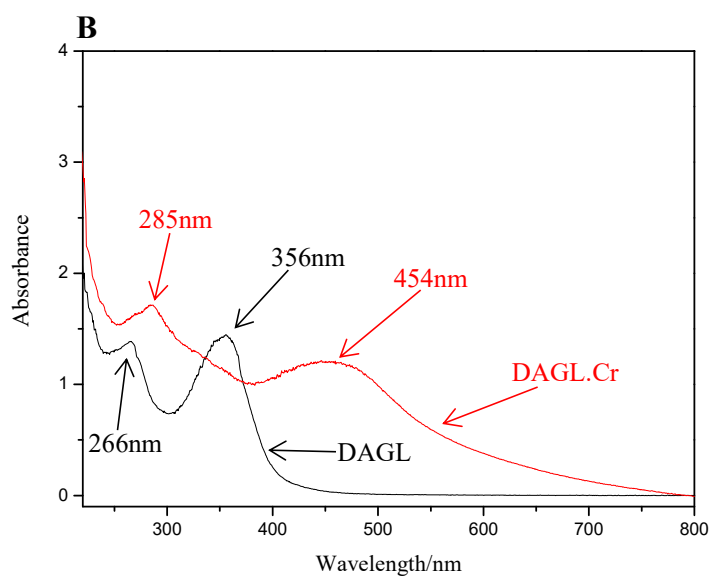


Fig. S3 (A) The FT-IR spectra of DAGL.Cr; (B) The UV-Vis spectra of DAGL and DAGL.Cr; The SEM images of DAGL(C: magnification 5000×) and DAGL.Cr(D: magnification 5000×)

Table S1 The correlation r value between caecum microbiota genus and hypoglycemic correlation parameters

	S_GSP	S_TC	S_TG	S_LDL_C	S_HDL_C	L_TC	L_TG	L_LDL_C	L_HDL_C	Bodyweight	FBG	AUC
Akkermansia	0.205353887	0.216213556	0.044988234	0.602678807	-0.504158082	0.200201722	0.274093467	0.314437694	-0.283319729	-0.256375777	-0.004042576	0.032577686
Dubosiella	0.040012004	0.10984815	-0.090454684	0.686750369	-0.566165743	0.264462877	0.093248017	0.107137215	-0.153468982	-0.038531559	-0.078971926	-0.001889607
Alloprevotella	-0.160204206	-0.325756655	0.047240904	0.130718426	0.171305863	0.148529293	0.227453205	0.200551522	0.110120736	0.242038733	-0.162587134	-0.220160441
Weissella	0.137608041	0.156507348	0.025711749	0.066720771	0.210934106	-0.418606736	-0.124503263	0.016072733	-0.28623584	-0.377078612	0.291254337	0.212182759
Intestinimonas	-0.096044741	-0.119995139	0.002512461	0.012077491	0.348922034	-0.089557079	0.18049196	0.264590226	-0.11071038	-0.408477538	0.04385716	0.039226811
Lactococcus	0.045876797	0.076258513	0.056542585	-0.057036255	0.210724987	-0.383548556	-0.308428851	-0.031176424	-0.105702997	-0.216760098	0.228781331	0.16102874
Oscillibacter	-0.020462742	-0.129908019	0.125526743	0.35709365	0.161027594	0.109643436	0.371555917	0.428710576	-0.047649919	-0.175688817	0.046121424	0.041815235
Parasutterella	0.089053186	-0.091732088	0.038314859	0.5400454	-0.221861766	0.402955428	0.307005928	0.270046436	0.026787931	0.116568089	-0.17290537	-0.125578575
Enterococcus	-0.173052176	-0.077069907	0.011282025	-0.037908966	0.213190216	-0.431233096	-0.366544073	-0.071321256	-0.002110307	-0.188791301	0.029957408	0.011038528
Desulfovibrio	0.222294258	0.358928644	0.093598055	0.225067877	-0.304064184	0.160291735	0.085656402	0.205758368	-0.231037278	-0.320421395	0.264286297	0.340356565
Alistipes	-0.281512095	-0.425185366	-0.242362856	-0.399529968	0.562619019	-0.376711774	0.151932582	-0.029438011	0.088242444	0.100234989	0.086237642	-0.012073576
Muribaculum	0.087277147	-0.274797407	0.035249787	0.03541616	0.2160859	-0.045379037	0.289372392	0.155143795	0.063368583	0.191807463	0.004863222	-0.184757506
Bacteroides	-0.141323285	-0.468376484	-0.124868325	0.05924065	0.361654714	-0.030872701	0.160845961	-0.025545382	0.198606272	0.260351673	-0.172799486	-0.364070983
Lactobacillus	0.033953243	0.260200154	-0.141884774	-0.123748937	-0.251610551	-0.161170083	-0.403289847	-0.372800382	0.02050077	0.005591119	-0.047495544	0.026983227
Ruminiclostridium	-0.257212318	-0.338330632	-0.022365382	0.096118	0.396515397	-0.039544589	0.273813865	0.312801682	0.040111827	-0.115959645	0.012563323	-0.062153073
Butyricoccus	-0.171192353	-0.09062171	-0.118338404	0.070646888	0.156277868	0.033961501	-0.17037488	-0.020928821	0.237487345	-0.098885516	-0.188819977	-0.141925031
Lachnoclostridium	0.34552895	0.513188283	0.319828215	0.068560315	-0.321785989	0.122437404	0.092942225	0.143297428	-0.389838749	-0.419495989	0.385070525	0.514788105
Helicobacter	-0.147499798	-0.057379042	-0.117914017	0.256281407	-0.061026015	0.161270717	0.188662427	-0.027089507	-0.039466753	-0.066210139	-0.03319418	-0.161513839
Erysipelatoclostridium	0.120257788	0.28023672	-0.132047186	0.363275244	-0.324456891	0.274145846	0.121022989	-0.036263339	-0.1420176	-0.203299166	0.013540358	-0.018076441
Enterorhabdus	0.064435079	0.328335229	-0.085909958	-0.052605982	-0.249635276	-0.03614702	-0.330429151	-0.173013781	-0.059893829	-0.269724851	0.046127032	0.116626821
Blautia	0.034038415	-0.111840506	0.138255198	0.106013941	-0.162047168	0.166862516	0.228858545	0.295713603	0.191823009	-0.055107582	0.035342277	0.154544351
Roseburia	-0.055674865	0.009765388	0.227147489	0.440936905	-0.302524414	0.434602919	0.142058347	0.187104673	-0.108103728	0.09821718	-0.114047177	0.025445705
Parabacteroides	0.097252614	-0.076464868	-0.027148588	0.430175069	-0.163546479	0.233964101	0.374650515	0.167808953	0.007779894	0.129421777	-0.166497792	-0.162810488
Mucispirillum	0.066661264	-0.038983669	0.155036877	0.147112462	0.098391215	-0.026015074	0.236080723	0.404980213	-0.081854284	-0.257557342	0.236178665	0.184617881

Table S1 The correlation r value between caecum microbiota genus and hypoglycemic correlation parameters (continued)

	HOMA_ISI	HOMA_IRI	HOMA_beta	IL_6	IL_10	PI3K	AKT_1	mTOR	GSK_3beta	GLUT_4	S6K1	IRS_1
Akkermansia	-0.177013594	0.172033046	-0.159295905	0.224614574	-0.094793719	0.065040806	0.158806015	0.332145434	0.290014892	0.350189716	-0.118961627	0.362926857
Dubosiella	-0.02185372	-0.014952545	-0.064246651	0.304801887	-0.137201928	0.1421897	0.15067565	0.273993071	0.336350115	0.345223054	0.079692138	0.317782668
Alloprevotella	0.096183454	0.012721822	-0.176890041	-0.424681954	0.064743538	0.592730666	0.420630419	0.49939227	-0.363584799	0.657078033	-0.029414148	0.583015963
Weissella	-0.327033978	0.279098194	-0.242598866	-0.045664715	-0.268472834	-0.426526214	-0.355260124	-0.299943365	0.035688232	-0.300024475	-0.127585428	-0.313975329
Intestinimonas	-0.149856144	0.162823685	-0.227337201	-0.445191888	-0.195242538	0.038096782	-0.103578233	0.185516882	-0.279369459	0.233172595	-0.294444225	0.239656365
Lactococcus	-0.155836882	0.133446991	-0.157297092	0.054757884	-0.214975396	-0.287736954	-0.252373003	-0.272004718	0.034801677	-0.387604696	0.111543838	-0.427760477
Oscillibacter	-0.162317667	0.250648299	-0.355348461	-0.328200974	-0.247974069	0.475989788	0.182009725	0.396353324	-0.198055106	0.481766614	-0.285980552	0.486790925
Parasutterella	0.068674515	-0.037908982	-0.06420986	-0.039288966	-0.054225267	0.51922134	0.301242464	0.539411527	0.144573654	0.598426151	0.080850847	0.584139254
Enterococcus	-0.039771168	-0.081977306	0.064689023	-0.084249944	-0.052838838	-0.189341893	-0.138306267	-0.127024241	-0.070289452	-0.222312714	0.178158601	-0.280751982
Desulfovibrio	-0.207212318	0.286385738	-0.269124798	0.427633713	-0.356482983	-0.221339709	-0.419367911	-0.21102107	0.316207456	-0.429983794	-0.244813615	-0.367747165
Alistipes	0.11174135	-0.011101207	-0.033951868	-0.55757232	0.240256057	0.07933871	0.195365043	0.05469573	-0.627258731	0.18466899	-0.084190908	0.2131918
Muribaculum	-0.046594546	0.076171954	-0.154774928	-0.356954743	0.029739476	0.281222142	0.194562619	0.301203355	-0.308253313	0.375268425	-0.085166728	0.431181881
Bacteroides	0.129730168	-0.077060206	-0.048213273	-0.498419901	0.202171623	0.568904741	0.541204116	0.522404991	-0.420954542	0.551251924	0.138967669	0.571995786
Lactobacillus	0.080463496	-0.147232801	0.287577992	0.436188315	0.049671826	-0.471818148	-0.269751236	-0.350457824	0.376873835	-0.54622802	0.240904303	-0.488210032
Ruminiclostridium	-0.034196345	0.143106033	-0.271220777	-0.513512419	-0.009318909	0.457897724	0.294315466	0.379482193	-0.448442122	0.442688708	-0.215631458	0.498602164
Butyrivibrio	0.193394131	-0.242593728	0.167456947	-0.212765966	0.067517733	-0.009079118	0.150516723	0.164620067	-0.009240122	0.191529896	0.041499495	0.182208721
Lachnospirillum	-0.406693137	0.31123896	-0.296005186	0.515760473	-0.331982821	-0.570363471	-0.347054534	-0.58269184	0.394700592	-0.516246657	-0.327120979	-0.527753018
Helicobacter	0.138984563	-0.144576362	0.061914989	-0.123748937	0.089955023	0.049278651	0.088334212	0.262571419	0.01013007	0.29879655	0.002188095	0.248389321
Erysipelatoclostridium	-0.004863616	-0.083248901	0.107810164	0.212540038	0.040692257	-0.372192958	-0.021156731	0.064767159	0.343776621	0.133425211	0.019940827	0.10959349
Enterorhabdus	0.007942619	-0.13332253	0.228552908	0.396239421	-0.02796126	-0.629772232	-0.420310419	-0.36690036	0.427037331	-0.521862474	0.114357501	-0.492847601
Blautia	-0.004457231	-0.009400705	-0.097005552	-0.038089064	-0.062239151	0.10593289	0.157623892	0.147007578	-0.019206613	0.222051138	-0.186636413	0.191336765
Roseburia	-0.030388979	0.053403566	-0.197163696	0.172366289	-0.308833064	0.530818171	0.147893031	0.250810374	0.22382496	0.328200974	0.036952999	0.281847651
Parabacteroides	0.038818429	-0.009400705	-0.063941003	-0.051055554	0.068722396	0.374209758	0.444264358	0.433810125	0.02739171	0.556748657	0.009724867	0.547753154
Mucispirillum	-0.209984604	0.218007945	-0.240132915	-0.170435208	-0.287543565	0.112259372	-0.125617961	0.08914823	-0.148472325	0.126266312	-0.334792127	0.105600131

Table S2 The correlation r value between caecum microbiota genus and fecal SCFA

	Acetic acid	Propionic acid	Isobutyric acid	Butyric acid	Isovaleric acid	Valeric acid	SCFA
Akkermansia	-0.204169938	-0.042620432	-0.286037302	-0.166236014	-0.008981317	-0.331410599	-0.156519862
Dubosiella	-0.059648285	0.037627834	-0.195138315	-0.115676835	-0.040421167	-0.234804257	-0.010433919
Alloprevotella	0.386289049	0.286119439	0.067909238	0.024390244	0.420144235	0.365853659	0.386921643
Weissella	-0.203106711	-0.334252734	-0.145076307	0.003406604	-0.149160587	-0.212588307	-0.15483826
Intestinimonas	0.086926569	0.032094664	0.166808512	0.04773676	0.27596548	0.069619485	0.226364636
Lactococcus	-0.070133494	-0.240447953	-0.078249273	0.075687564	-0.095887139	-0.132635763	-0.039669045
Oscillibacter	0.177154666	0.038654781	-0.06345733	0.00267423	0.228525122	0.134035657	0.257536468
Parasutterella	0.198401082	0.284601477	-0.057639311	-0.058933449	0.163731083	0.104635283	0.183781444
Enterococcus	0.023944837	-0.126131419	-0.062786718	0.14439369	-0.004058282	-0.105190682	0.071425772
Desulfovibrio	-0.245066656	-0.266450568	-0.052435368	0.092706645	-0.22471637	-0.368719612	-0.126175041
Alistipes	0.208257364	0.033789806	-0.017179903	0.169435216	0.261810226	0.379142695	0.179483024
Muribaculum	0.24076175	0.128276812	0.037319178	-0.043515255	0.325999757	0.282808638	0.16312143
Bacteroides	0.459705847	0.277368123	0.146839547	0.142370959	0.438457175	0.392431732	0.414147962
Lactobacillus	-0.246667477	-0.102503849	0.004132901	0.128757799	-0.299408476	-0.274288956	-0.252086541
Ruminiclostridium	0.29465154	0.162959362	-0.01872037	0.119606175	0.3353997	0.25930878	0.363923666
Butyricicoccus	0.144524605	0.201985824	0.109998786	0.140790279	0.093617025	0.053090174	0.132765963
Lachnoclostridium	-0.578339614	-0.452880642	-0.297811994	-0.321286768	-0.523215299	-0.504416174	-0.492747751
Helicobacter	0.111516331	0.154058107	-0.086841999	-0.087361725	0.022448236	0.085254671	-0.016694356
Erysipelatoclostridium	-0.291423491	-0.070360318	-0.243524796	-0.389656736	-0.278685221	-0.341831174	-0.332022881
Enterorhabdus	-0.287972122	-0.107387448	-0.076028369	0.04943875	-0.356121092	-0.320784543	-0.296065168
Blautia	-0.023867412	-0.01880141	-0.290067675	-0.06069938	0.085659873	-0.060051056	-0.150411282
Roseburia	0.176182179	0.139951378	0.094416079	0.0636953	0.00089141	0.033873582	0.245056727
Parabacteroides	0.097293136	0.137606873	-0.221015521	-0.223347787	0.091089591	0.066858463	0.026581304
Mucispirillum	0.070146291	-0.131047899	-0.310585185	0.015398331	0.03476781	0.123429777	-0.06848205