Metabolic modeling PhenComm project biological results

5-23-23

These are the consistent observations that are exciting and concrete.

* E. coli growth on maltose is inhibited by increasing concentrations of acetate. Also, pseudomonas fluorescens consumes acetate much more quickly and effectively than e coli (excel file “PF-EC Acetate and Carbon 6-24-22” also “PF-EC-PFEC on Acetate 6-17-22” for relative acetate consumption rates and efficiency aka yields)
* Knocking out Pta eliminates acetate consumption and production (Excel file “Acetate KO Ecoli only 10-21-22”) and instead produces lactate (PMID 19852855).
* Pta KO increases growth on maltose, implying acetate production compared to lactate production is inhibitory (comparing F7 to F10 in Excel “Acetate KO Ecoli only 10-21-22”).
* Lactate production results in much greater pseudomonas fluorescens growth (comparing well G7 to G10, and column 7 to column 10 more broadly in Excel sheet “PF-ECKOs Ace maltose”)
* Based on metabolomics data, lactate is produced much more when Pta is knocked out (Excel sheet “TMS metabolomics with Graphs 3-28-23”).
* Moreover, when 4-hydroxybenzoate is present in the media there is a large increase in the total amount of lactate produced and a delay in its consumption (same excel sheet).
* There are no other metabolites that both increase over time and are produced in high enough concentrations to support observed pseudomonas growth

Conclusions

* Thus, 4-HB inhibits pseudomonas from consuming lactate and acetate (based on earlier metabolomics data from 08-2022), but E. coli does not consume these excess secondary metabolites either like they normally do. This dynamic could be caused by several mechanisms. 1. The pseudomonas may delay their consumption of acetate/lactate, but still transmit some signal to the e coli that prevents them from metabolizing the organic acids 2. The 4HB, which is an acid, could be inhibiting the E coli organic acid metabolism through physical interaction or other means (we know 4HB doesn’t inhibit e. coli consumption of maltose from earlier experiments – excel sheet needs to be found…). 3. The decreasing concentration of 4HB due to pseudomonas stimulates increased E coli acetate/lactate production that is not matched by increased psudomonas acetate/lactate consumption. Whatever the case, there is clearly a dynamic interplay between secondary metabolites and organism cocultures that has yet to be studied in depth.
* E. coli produces acetate/lactate when consuming maltose that results in pseudomonas cross-feeding
* PhenComm can use minimal data (OD and fluorescence) to generate qualitative and quantitative temporal and molecular hypotheses that, if pursued with simple experiments, lead to intriguing discoveries