Tukey Tatum

Caitlin Nordheim-Maestas

# Experiment:

Bd was incubated with aquatic environmental biofilm collected from one pond at UCSB in a 12-well plate, incubated in one of three media (TB broth, MilliQ control water, and microbe depleted pond water filtered through a 0.22 micron filter) and the biofilm was destructively sampled and Bd was quantified the AE biofilm at day 1, 3, 5, 7.

# Statistical test

Test: 2-way ANOVA with outcome variable of log-transformed Bd quantity and predictor variables of the day and medium with the AE biofilm and Bd and their interaction (logBd ~ day\*medium). The log-transformed Bd quantity data pass the assumptions of an ANOVA.

Predictors:

Day: 1, 3, 5, 7 (as factors)

Medium: medium incubated with Bd and aquatic environmental biofilm, either none (milliQ), adding TB proth, or adding filtered (aka microbe depleted) pond water.

# Load in data and libraries

## read in and clean data  
library(tidyverse) # for cleaning and viewing data  
library(broom) # cleaning  
library(here) # for importing data  
library(car) # stats tests like Levene's  
library(multcomp)  
library(gt)  
library(modelsummary)  
library(emmeans)  
  
fig\_3b\_raw <- read.csv(here("data", "final\_NCOS\_2024\_reformatted\_for\_R.xlsx - Fig3B.csv"))  
  
# set up custom theme  
myCustomTheme <- function() {  
 theme\_light() +  
 theme(axis.text = element\_text(size = 12, family = "Times", color = "black"),  
 axis.title.x = element\_text(margin = margin(t = 10), size = 14, face = "bold", family = "Times", color = "black"), # Add space between x-axis label and axis  
 axis.title.y = element\_text(margin = margin(r = 10), size = 14, face = "bold", family = "Times", color = "black"), # Add space between y-axis label and axis  
 title = element\_text(size = 12, face = "bold", family = "Times"),  
 plot.caption = element\_text(size = 10, face = "italic", family = "Times"),  
 legend.text = element\_text(size = 10, family = "Times"), # Increase legend text size  
 panel.grid.major.x = element\_blank(), # Remove major vertical grid lines  
 panel.grid.minor.x = element\_blank(), # Remove minor vertical grid lines  
 panel.grid.major.y = element\_blank(), # Remove major horizontal grid lines  
 panel.grid.minor.y = element\_blank(), # Remove minor horizontal grid lines  
 strip.text = element\_text(size = 12, face = "bold", family = "Times", color = "black"), # Set strip text style  
 strip.background = element\_rect(fill = "white", color = "grey"), # Set strip background to white, # color = "black"  
 axis.ticks = element\_blank() # Remove x and y axis ticks  
 )}

# Data clean

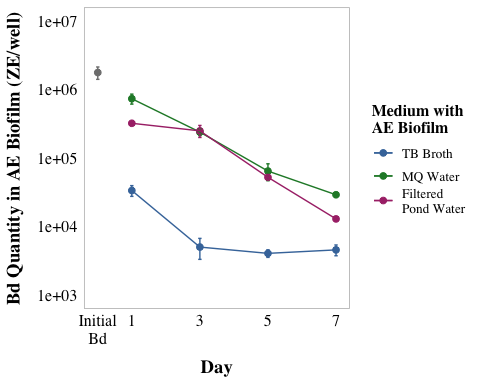
# add column for microbes or no  
ae <- fig\_3b\_raw %>%   
 rename(sample\_ID = Adherent.sample.ID) %>%   
   
 # add columns for components y/n  
 # add column for TB or no  
 mutate(TB = case\_when(  
 str\_detect(sample\_ID, "TB") ~ "y",  
 TRUE ~ "n"  
 )) %>%   
 # add column for PW or no  
 mutate(PW = case\_when(  
 str\_detect(sample\_ID, "PW") ~ "y",  
 TRUE ~ "n"  
 ))  
  
# control data for ae  
ae\_control\_data <- ae %>%   
 filter(day == 0) %>%   
 dplyr::select(day, adh)  
  
# no day 0 for stats  
ae\_noday0 <- ae %>%   
 filter(day != 0) %>%   
 mutate(log\_adh = log(adh)) # note: no zeroes so not log + 1  
  
# quick check: we want day as a FACTOR  
ae\_noday0 <- ae\_noday0 %>%   
 mutate(day = as.factor(day)) %>%   
# column for medium  
mutate(medium = sample\_ID)  
str(ae\_noday0$day)

Factor w/ 4 levels "1","3","5","7": 1 2 3 4 1 2 3 4 1 2 ...

# set MQ as reference  
ae\_noday0$sample\_ID <- factor(ae\_noday0$sample\_ID)  
ae\_noday0$sample\_ID <- relevel(ae\_noday0$sample\_ID, ref = "MQ+AEbiofilm")

# EDA

ae\_summary <- ae %>%  
 group\_by(day, sample\_ID) %>%  
 reframe(mean = mean(adh), # calculate the mean  
 n = length(adh), # count the number of observations  
 df = n - 1, # calculate the degrees of freedom  
 sd = sd(adh), # calculate the standard deviation  
 se = sd/sqrt(n), # calculate the standard error  
 ) %>%  
 # add column for TB or no  
 mutate(TB = case\_when(str\_detect(sample\_ID, "TB") ~ "y", TRUE ~ "n")) %>%  
 # add column for PW or no  
 mutate(PW = case\_when(str\_detect(sample\_ID, "PW") ~ "y", TRUE ~ "n"))  
  
ae\_summary %>%  
 # reorder to match Renwei's plot  
 mutate(sample\_ID = factor(sample\_ID,  
 levels = c("1%TB+AEbiofilm", "MQ+AEbiofilm",  
 "PW+AEBiofilm", "Added Bd" ))) %>%  
  
 ggplot(aes(x = day,  
 y = mean,  
 color = sample\_ID)) +  
 geom\_point(size = 2) +  
 geom\_errorbar(aes(ymin = mean - se, # plot the standard error  
 ymax = mean + se),  
 width = 0.1) +  
 geom\_line() +   
 scale\_y\_log10(limits = c(1e3, 1e7),  
 breaks = c(1e3, 1e4, 1e5, 1e6, 1e7)) +  
 # vibes  
 labs(x = "Day",  
 y = "Bd Quantity in AE Biofilm (ZE/well)",  
 color = "Medium with\nAE Biofilm")+ # Title for color legend  
   
 scale\_color\_manual(values = c("1%TB+AEbiofilm"= "#4477AA",  
 "MQ+AEbiofilm" = "#228833",  
 #"Added Bd" = "darkgrey",  
 "PW+AEBiofilm" = "#AA3377"),  
 labels = c("1%TB+AEbiofilm" = "TB Broth",  
 "MQ+AEbiofilm" = "MQ Water",  
 "PW+AEBiofilm" = "Filtered\nPond Water",  
 "Added Bd" = "Initial Bd")) + # Custom labels  
  
 myCustomTheme()+  
 scale\_x\_continuous(breaks = c(0, 1, 3, 5, 7),  
 labels = c("Initial\nBd", "1", "3", "5", "7"))

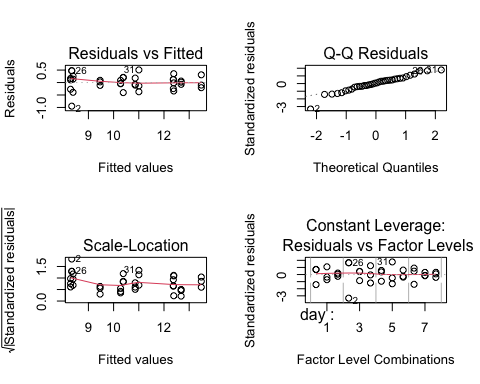


**Current legend:** Inhibitory effect of aquatic environmental biofilm on Bd growth. Bd was incubated with aquatic environmental biofilm collected from one pond at UCSB in a 12-well plate, incubated in one of three media (TB broth, MilliQ control water, and microbe depleted pond water filtered through a 0.22 micron filter) and the biofilm was destructively sampled and Bd was quantified the AE biofilm at day 1, 3, 5, 7. Scatterplot of Bd quantity in the aquatic environmental biofilm from UCSB. X-axis indicates the duration of Bd in the microorganism-depleted pond water (“Filtered pond water”), or 1%TB or MQ. Y-axis represents the mean Bd quantity of the triplicate data as zoospore equivalents per well, and the bar represents the standard error.

# 2 way anova

Note: Cherie says homoskedasticity is good enough

# build model  
mod1 <- aov(log\_adh ~ day\*medium,  
 data = ae\_noday0)  
  
# diagnostic plot  
par(mfrow = c(2,2))  
plot(mod1) # kinda not homoskedastic but Cherie says it is good enough



# look at results  
summary(mod1)

Df Sum Sq Mean Sq F value Pr(>F)   
day 3 40.24 13.413 110.10 3.64e-14 \*\*\*  
medium 2 60.07 30.036 246.55 < 2e-16 \*\*\*  
day:medium 6 7.42 1.236 10.14 1.30e-05 \*\*\*  
Residuals 24 2.92 0.122   
---  
Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

AIC(mod1) # 37.78083 better than null

[1] 37.78083

Prettier anova table

anova\_output <- tidy(mod1)  
  
anova\_output %>%  
 dplyr::select(term, df, sumsq, meansq, statistic, p.value) %>%  
 gt() %>%  
 tab\_header(  
 title = "ANOVA Table"  
 ) %>%  
 fmt\_number(  
 columns = c(sumsq, meansq, statistic),  
 decimals = 2  
 ) %>%  
 cols\_label(  
 term = "Term",  
 df = "Df",  
 sumsq = "Sum Sq",  
 meansq = "Mean Sq",  
 statistic = "F value",  
 p.value = "P-value"  
 ) %>% # scientific number format for values <0.001 in p values  
 fmt\_scientific(  
 columns = c(p.value),  
 decimals = 1,  
 rows = p.value < 0.001  
 ) %>%  
 # 3 decimals for p values >=0.001  
 fmt\_number(  
 columns = c(p.value),  
 decimals = 3,  
 rows = p.value >= 0.001  
 )

Table 1: ANOVA Table

| Term | Df | Sum Sq | Mean Sq | F value | P-value |
| --- | --- | --- | --- | --- | --- |
| day | 3 | 40.24 | 13.41 | 110.10 | 3.6 × 10^-14 |
| medium | 2 | 60.07 | 30.04 | 246.55 | 1.0 × 10^-16 |
| day:medium | 6 | 7.42 | 1.24 | 10.14 | 1.3 × 10^-5 |
| Residuals | 24 | 2.92 | 0.12 | NA | NA |

# Post Hoc using TukeyHSD

TukeyHSD(mod1) # all days sig diff from each other, all media sig diff from each other

Tukey multiple comparisons of means  
 95% family-wise confidence level  
  
Fit: aov(formula = log\_adh ~ day \* medium, data = ae\_noday0)  
  
$day  
 diff lwr upr p adj  
3-1 -1.1493419 -1.603234 -0.6954497 0.0000018  
5-1 -2.1306208 -2.584513 -1.6767286 0.0000000  
7-1 -2.8046545 -3.258547 -2.3507623 0.0000000  
5-3 -0.9812789 -1.435171 -0.5273867 0.0000210  
7-3 -1.6553126 -2.109205 -1.2014204 0.0000000  
7-5 -0.6740337 -1.127926 -0.2201415 0.0021838  
  
$medium  
 diff lwr upr p adj  
MQ+AEbiofilm-1%TB+AEbiofilm 2.9323391 2.5764935 3.28818480 0.0000000  
PW+AEBiofilm-1%TB+AEbiofilm 2.4957994 2.1399538 2.85164510 0.0000000  
PW+AEBiofilm-MQ+AEbiofilm -0.4365397 -0.7923854 -0.08069402 0.0142222  
  
$`day:medium`  
 diff lwr upr p adj  
3:1%TB+AEbiofilm-1:1%TB+AEbiofilm -2.04493896 -3.07249206 -1.01738586 0.0000113  
5:1%TB+AEbiofilm-1:1%TB+AEbiofilm -2.09173123 -3.11928433 -1.06417813 0.0000078  
7:1%TB+AEbiofilm-1:1%TB+AEbiofilm -1.99414642 -3.02169952 -0.96659332 0.0000169  
1:MQ+AEbiofilm-1:1%TB+AEbiofilm 3.09761537 2.07006227 4.12516848 0.0000000  
3:MQ+AEbiofilm-1:1%TB+AEbiofilm 1.98759548 0.96004238 3.01514858 0.0000179  
5:MQ+AEbiofilm-1:1%TB+AEbiofilm 0.61984147 -0.40771163 1.64739458 0.5802121  
7:MQ+AEbiofilm-1:1%TB+AEbiofilm -0.10651243 -1.13406553 0.92104068 0.9999997  
1:PW+AEBiofilm-1:1%TB+AEbiofilm 2.29587354 1.26832044 3.32342665 0.0000016  
3:PW+AEBiofilm-1:1%TB+AEbiofilm 2.00280682 0.97525371 3.03035992 0.0000158  
5:PW+AEBiofilm-1:1%TB+AEbiofilm 0.47351640 -0.55403671 1.50106950 0.8683022  
7:PW+AEBiofilm-1:1%TB+AEbiofilm -0.91981565 -1.94736875 0.10773746 0.1093965  
5:1%TB+AEbiofilm-3:1%TB+AEbiofilm -0.04679227 -1.07434537 0.98076083 1.0000000  
7:1%TB+AEbiofilm-3:1%TB+AEbiofilm 0.05079254 -0.97676056 1.07834564 1.0000000  
1:MQ+AEbiofilm-3:1%TB+AEbiofilm 5.14255433 4.11500123 6.17010744 0.0000000  
3:MQ+AEbiofilm-3:1%TB+AEbiofilm 4.03253444 3.00498134 5.06008754 0.0000000  
5:MQ+AEbiofilm-3:1%TB+AEbiofilm 2.66478043 1.63722733 3.69233354 0.0000001  
7:MQ+AEbiofilm-3:1%TB+AEbiofilm 1.93842653 0.91087343 2.96597964 0.0000266  
1:PW+AEBiofilm-3:1%TB+AEbiofilm 4.34081250 3.31325940 5.36836561 0.0000000  
3:PW+AEBiofilm-3:1%TB+AEbiofilm 4.04774578 3.02019267 5.07529888 0.0000000  
5:PW+AEBiofilm-3:1%TB+AEbiofilm 2.51845536 1.49090225 3.54600846 0.0000003  
7:PW+AEBiofilm-3:1%TB+AEbiofilm 1.12512331 0.09757021 2.15267642 0.0234402  
7:1%TB+AEbiofilm-5:1%TB+AEbiofilm 0.09758481 -0.92996829 1.12513791 0.9999999  
1:MQ+AEbiofilm-5:1%TB+AEbiofilm 5.18934660 4.16179350 6.21689970 0.0000000  
3:MQ+AEbiofilm-5:1%TB+AEbiofilm 4.07932671 3.05177361 5.10687981 0.0000000  
5:MQ+AEbiofilm-5:1%TB+AEbiofilm 2.71157270 1.68401960 3.73912581 0.0000001  
7:MQ+AEbiofilm-5:1%TB+AEbiofilm 1.98521880 0.95766570 3.01277191 0.0000182  
1:PW+AEBiofilm-5:1%TB+AEbiofilm 4.38760477 3.36005167 5.41515788 0.0000000  
3:PW+AEBiofilm-5:1%TB+AEbiofilm 4.09453805 3.06698494 5.12209115 0.0000000  
5:PW+AEBiofilm-5:1%TB+AEbiofilm 2.56524763 1.53769452 3.59280073 0.0000002  
7:PW+AEBiofilm-5:1%TB+AEbiofilm 1.17191558 0.14436248 2.19946869 0.0161067  
1:MQ+AEbiofilm-7:1%TB+AEbiofilm 5.09176179 4.06420869 6.11931489 0.0000000  
3:MQ+AEbiofilm-7:1%TB+AEbiofilm 3.98174190 2.95418880 5.00929500 0.0000000  
5:MQ+AEbiofilm-7:1%TB+AEbiofilm 2.61398789 1.58643479 3.64154100 0.0000001  
7:MQ+AEbiofilm-7:1%TB+AEbiofilm 1.88763399 0.86008089 2.91518710 0.0000404  
1:PW+AEBiofilm-7:1%TB+AEbiofilm 4.29001996 3.26246686 5.31757307 0.0000000  
3:PW+AEBiofilm-7:1%TB+AEbiofilm 3.99695324 2.96940013 5.02450634 0.0000000  
5:PW+AEBiofilm-7:1%TB+AEbiofilm 2.46766282 1.44010971 3.49521592 0.0000004  
7:PW+AEBiofilm-7:1%TB+AEbiofilm 1.07433077 0.04677767 2.10188388 0.0349376  
3:MQ+AEbiofilm-1:MQ+AEbiofilm -1.11001989 -2.13757300 -0.08246679 0.0264194  
5:MQ+AEbiofilm-1:MQ+AEbiofilm -2.47777390 -3.50532700 -1.45022079 0.0000004  
7:MQ+AEbiofilm-1:MQ+AEbiofilm -3.20412780 -4.23168090 -2.17657470 0.0000000  
1:PW+AEBiofilm-1:MQ+AEbiofilm -0.80174183 -1.82929493 0.22581127 0.2352787  
3:PW+AEBiofilm-1:MQ+AEbiofilm -1.09480855 -2.12236166 -0.06725545 0.0297786  
5:PW+AEBiofilm-1:MQ+AEbiofilm -2.62409897 -3.65165208 -1.59654587 0.0000001  
7:PW+AEBiofilm-1:MQ+AEbiofilm -4.01743102 -5.04498412 -2.98987792 0.0000000  
5:MQ+AEbiofilm-3:MQ+AEbiofilm -1.36775401 -2.39530711 -0.34020090 0.0031814  
7:MQ+AEbiofilm-3:MQ+AEbiofilm -2.09410791 -3.12166101 -1.06655480 0.0000076  
1:PW+AEBiofilm-3:MQ+AEbiofilm 0.30827806 -0.71927504 1.33583117 0.9927584  
3:PW+AEBiofilm-3:MQ+AEbiofilm 0.01521134 -1.01234177 1.04276444 1.0000000  
5:PW+AEBiofilm-3:MQ+AEbiofilm -1.51407908 -2.54163219 -0.48652598 0.0009231  
7:PW+AEBiofilm-3:MQ+AEbiofilm -2.90741113 -3.93496423 -1.87985802 0.0000000  
7:MQ+AEbiofilm-5:MQ+AEbiofilm -0.72635390 -1.75390700 0.30119920 0.3586125  
1:PW+AEBiofilm-5:MQ+AEbiofilm 1.67603207 0.64847897 2.70358517 0.0002348  
3:PW+AEBiofilm-5:MQ+AEbiofilm 1.38296534 0.35541224 2.41051845 0.0027988  
5:PW+AEBiofilm-5:MQ+AEbiofilm -0.14632508 -1.17387818 0.88122803 0.9999930  
7:PW+AEBiofilm-5:MQ+AEbiofilm -1.53965712 -2.56721022 -0.51210402 0.0007432  
1:PW+AEBiofilm-7:MQ+AEbiofilm 2.40238597 1.37483287 3.42993907 0.0000007  
3:PW+AEBiofilm-7:MQ+AEbiofilm 2.10931925 1.08176614 3.13687235 0.0000067  
5:PW+AEBiofilm-7:MQ+AEbiofilm 0.58002883 -0.44752428 1.60758193 0.6677092  
7:PW+AEBiofilm-7:MQ+AEbiofilm -0.81330322 -1.84085632 0.21424988 0.2194307  
3:PW+AEBiofilm-1:PW+AEBiofilm -0.29306673 -1.32061983 0.73448638 0.9952000  
5:PW+AEBiofilm-1:PW+AEBiofilm -1.82235715 -2.84991025 -0.79480404 0.0000692  
7:PW+AEBiofilm-1:PW+AEBiofilm -3.21568919 -4.24324229 -2.18813609 0.0000000  
5:PW+AEBiofilm-3:PW+AEBiofilm -1.52929042 -2.55684352 -0.50173732 0.0008115  
7:PW+AEBiofilm-3:PW+AEBiofilm -2.92262246 -3.95017557 -1.89506936 0.0000000  
7:PW+AEBiofilm-5:PW+AEBiofilm -1.39333205 -2.42088515 -0.36577894 0.0025645

# Post hoc using emmeans

# use emmeans package to get the t value  
mod1 <- aov(log\_adh ~ day\*medium,  
 data = ae\_noday0)  
  
# Perform pairwise comparisons for 'day'  
em\_day <- emmeans(mod1, ~ day)

NOTE: Results may be misleading due to involvement in interactions

tukey\_day <- pairs(em\_day, adjust = "tukey")  
  
# Perform pairwise comparisons for 'medium'  
em\_medium <- emmeans(mod1, ~ medium)

NOTE: Results may be misleading due to involvement in interactions

tukey\_medium <- pairs(em\_medium, adjust = "tukey")  
  
# Perform pairwise comparisons for 'day \* medium' (interaction)  
em\_interaction <- emmeans(mod1, ~ day \* medium)  
tukey\_interaction <- pairs(em\_interaction, adjust = "tukey")  
  
tukey\_day

contrast estimate SE df t.ratio p.value  
 day1 - day3 1.149 0.165 24 6.985 <.0001  
 day1 - day5 2.131 0.165 24 12.949 <.0001  
 day1 - day7 2.805 0.165 24 17.046 <.0001  
 day3 - day5 0.981 0.165 24 5.964 <.0001  
 day3 - day7 1.655 0.165 24 10.060 <.0001  
 day5 - day7 0.674 0.165 24 4.097 0.0022  
  
Results are averaged over the levels of: medium   
P value adjustment: tukey method for comparing a family of 4 estimates

tukey\_medium

contrast estimate SE df t.ratio p.value  
 (1%TB+AEbiofilm) - (MQ+AEbiofilm) -2.932 0.142 24 -20.579 <.0001  
 (1%TB+AEbiofilm) - (PW+AEBiofilm) -2.496 0.142 24 -17.515 <.0001  
 (MQ+AEbiofilm) - (PW+AEBiofilm) 0.437 0.142 24 3.064 0.0142  
  
Results are averaged over the levels of: day   
P value adjustment: tukey method for comparing a family of 3 estimates

tukey\_interaction

contrast estimate SE df t.ratio  
 (day1 1%TB+AEbiofilm) - (day3 1%TB+AEbiofilm) 2.0449 0.285 24 7.176  
 (day1 1%TB+AEbiofilm) - (day5 1%TB+AEbiofilm) 2.0917 0.285 24 7.340  
 (day1 1%TB+AEbiofilm) - (day7 1%TB+AEbiofilm) 1.9941 0.285 24 6.997  
 (day1 1%TB+AEbiofilm) - (day1 MQ+AEbiofilm) -3.0976 0.285 24 -10.869  
 (day1 1%TB+AEbiofilm) - (day3 MQ+AEbiofilm) -1.9876 0.285 24 -6.974  
 (day1 1%TB+AEbiofilm) - (day5 MQ+AEbiofilm) -0.6198 0.285 24 -2.175  
 (day1 1%TB+AEbiofilm) - (day7 MQ+AEbiofilm) 0.1065 0.285 24 0.374  
 (day1 1%TB+AEbiofilm) - (day1 PW+AEBiofilm) -2.2959 0.285 24 -8.056  
 (day1 1%TB+AEbiofilm) - (day3 PW+AEBiofilm) -2.0028 0.285 24 -7.028  
 (day1 1%TB+AEbiofilm) - (day5 PW+AEBiofilm) -0.4735 0.285 24 -1.662  
 (day1 1%TB+AEbiofilm) - (day7 PW+AEBiofilm) 0.9198 0.285 24 3.228  
 (day3 1%TB+AEbiofilm) - (day5 1%TB+AEbiofilm) 0.0468 0.285 24 0.164  
 (day3 1%TB+AEbiofilm) - (day7 1%TB+AEbiofilm) -0.0508 0.285 24 -0.178  
 (day3 1%TB+AEbiofilm) - (day1 MQ+AEbiofilm) -5.1426 0.285 24 -18.045  
 (day3 1%TB+AEbiofilm) - (day3 MQ+AEbiofilm) -4.0325 0.285 24 -14.150  
 (day3 1%TB+AEbiofilm) - (day5 MQ+AEbiofilm) -2.6648 0.285 24 -9.351  
 (day3 1%TB+AEbiofilm) - (day7 MQ+AEbiofilm) -1.9384 0.285 24 -6.802  
 (day3 1%TB+AEbiofilm) - (day1 PW+AEBiofilm) -4.3408 0.285 24 -15.232  
 (day3 1%TB+AEbiofilm) - (day3 PW+AEBiofilm) -4.0477 0.285 24 -14.203  
 (day3 1%TB+AEbiofilm) - (day5 PW+AEBiofilm) -2.5185 0.285 24 -8.837  
 (day3 1%TB+AEbiofilm) - (day7 PW+AEBiofilm) -1.1251 0.285 24 -3.948  
 (day5 1%TB+AEbiofilm) - (day7 1%TB+AEbiofilm) -0.0976 0.285 24 -0.342  
 (day5 1%TB+AEbiofilm) - (day1 MQ+AEbiofilm) -5.1893 0.285 24 -18.209  
 (day5 1%TB+AEbiofilm) - (day3 MQ+AEbiofilm) -4.0793 0.285 24 -14.314  
 (day5 1%TB+AEbiofilm) - (day5 MQ+AEbiofilm) -2.7116 0.285 24 -9.515  
 (day5 1%TB+AEbiofilm) - (day7 MQ+AEbiofilm) -1.9852 0.285 24 -6.966  
 (day5 1%TB+AEbiofilm) - (day1 PW+AEBiofilm) -4.3876 0.285 24 -15.396  
 (day5 1%TB+AEbiofilm) - (day3 PW+AEBiofilm) -4.0945 0.285 24 -14.368  
 (day5 1%TB+AEbiofilm) - (day5 PW+AEBiofilm) -2.5652 0.285 24 -9.001  
 (day5 1%TB+AEbiofilm) - (day7 PW+AEBiofilm) -1.1719 0.285 24 -4.112  
 (day7 1%TB+AEbiofilm) - (day1 MQ+AEbiofilm) -5.0918 0.285 24 -17.867  
 (day7 1%TB+AEbiofilm) - (day3 MQ+AEbiofilm) -3.9817 0.285 24 -13.972  
 (day7 1%TB+AEbiofilm) - (day5 MQ+AEbiofilm) -2.6140 0.285 24 -9.172  
 (day7 1%TB+AEbiofilm) - (day7 MQ+AEbiofilm) -1.8876 0.285 24 -6.624  
 (day7 1%TB+AEbiofilm) - (day1 PW+AEBiofilm) -4.2900 0.285 24 -15.053  
 (day7 1%TB+AEbiofilm) - (day3 PW+AEBiofilm) -3.9970 0.285 24 -14.025  
 (day7 1%TB+AEbiofilm) - (day5 PW+AEBiofilm) -2.4677 0.285 24 -8.659  
 (day7 1%TB+AEbiofilm) - (day7 PW+AEBiofilm) -1.0743 0.285 24 -3.770  
 (day1 MQ+AEbiofilm) - (day3 MQ+AEbiofilm) 1.1100 0.285 24 3.895  
 (day1 MQ+AEbiofilm) - (day5 MQ+AEbiofilm) 2.4778 0.285 24 8.694  
 (day1 MQ+AEbiofilm) - (day7 MQ+AEbiofilm) 3.2041 0.285 24 11.243  
 (day1 MQ+AEbiofilm) - (day1 PW+AEBiofilm) 0.8017 0.285 24 2.813  
 (day1 MQ+AEbiofilm) - (day3 PW+AEBiofilm) 1.0948 0.285 24 3.842  
 (day1 MQ+AEbiofilm) - (day5 PW+AEBiofilm) 2.6241 0.285 24 9.208  
 (day1 MQ+AEbiofilm) - (day7 PW+AEBiofilm) 4.0174 0.285 24 14.097  
 (day3 MQ+AEbiofilm) - (day5 MQ+AEbiofilm) 1.3678 0.285 24 4.799  
 (day3 MQ+AEbiofilm) - (day7 MQ+AEbiofilm) 2.0941 0.285 24 7.348  
 (day3 MQ+AEbiofilm) - (day1 PW+AEBiofilm) -0.3083 0.285 24 -1.082  
 (day3 MQ+AEbiofilm) - (day3 PW+AEBiofilm) -0.0152 0.285 24 -0.053  
 (day3 MQ+AEbiofilm) - (day5 PW+AEBiofilm) 1.5141 0.285 24 5.313  
 (day3 MQ+AEbiofilm) - (day7 PW+AEBiofilm) 2.9074 0.285 24 10.202  
 (day5 MQ+AEbiofilm) - (day7 MQ+AEbiofilm) 0.7264 0.285 24 2.549  
 (day5 MQ+AEbiofilm) - (day1 PW+AEBiofilm) -1.6760 0.285 24 -5.881  
 (day5 MQ+AEbiofilm) - (day3 PW+AEBiofilm) -1.3830 0.285 24 -4.853  
 (day5 MQ+AEbiofilm) - (day5 PW+AEBiofilm) 0.1463 0.285 24 0.513  
 (day5 MQ+AEbiofilm) - (day7 PW+AEBiofilm) 1.5397 0.285 24 5.403  
 (day7 MQ+AEbiofilm) - (day1 PW+AEBiofilm) -2.4024 0.285 24 -8.430  
 (day7 MQ+AEbiofilm) - (day3 PW+AEBiofilm) -2.1093 0.285 24 -7.401  
 (day7 MQ+AEbiofilm) - (day5 PW+AEBiofilm) -0.5800 0.285 24 -2.035  
 (day7 MQ+AEbiofilm) - (day7 PW+AEBiofilm) 0.8133 0.285 24 2.854  
 (day1 PW+AEBiofilm) - (day3 PW+AEBiofilm) 0.2931 0.285 24 1.028  
 (day1 PW+AEBiofilm) - (day5 PW+AEBiofilm) 1.8224 0.285 24 6.395  
 (day1 PW+AEBiofilm) - (day7 PW+AEBiofilm) 3.2157 0.285 24 11.284  
 (day3 PW+AEBiofilm) - (day5 PW+AEBiofilm) 1.5293 0.285 24 5.366  
 (day3 PW+AEBiofilm) - (day7 PW+AEBiofilm) 2.9226 0.285 24 10.255  
 (day5 PW+AEBiofilm) - (day7 PW+AEBiofilm) 1.3933 0.285 24 4.889  
 p.value  
 <.0001  
 <.0001  
 <.0001  
 <.0001  
 <.0001  
 0.5802  
 1.0000  
 <.0001  
 <.0001  
 0.8683  
 0.1094  
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 0.0349  
 0.0264  
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 <.0001  
 0.2353  
 0.0298  
 <.0001  
 <.0001  
 0.0032  
 <.0001  
 0.9928  
 1.0000  
 0.0009  
 <.0001  
 0.3586  
 0.0002  
 0.0028  
 1.0000  
 0.0007  
 <.0001  
 <.0001  
 0.6677  
 0.2194  
 0.9952  
 0.0001  
 <.0001  
 0.0008  
 <.0001  
 0.0026  
  
P value adjustment: tukey method for comparing a family of 12 estimates

# Results write up

A two-way ANOVA revealed that there was a statistically significant difference in Bd load across days (F(3, 24) = 110.100, p = p <0.0001), across the media (F(2, 24) = 246.55, p <0.0001), and the interaction between the effects of day and medium were also significant (F(6, 24) = 10.145, p = p <0.0001). Bd was significantly lower with each day (Tukey-Kramer with 95% family-wise confidence level, p <0.005 for all) and TB plus biofilm has most Bd inhibition power, followed by pond water with no microbes, then by milliQ with the least inhibition power (Tukey-Kramer with 95% family-wise confidence level, p <0.05 for all). **what do I even say for the interactions?**

# Big ol’ table emmeans

# Convert Tukey emmeans results to data frames  
tukey\_day\_df <- as.data.frame(tukey\_day)  
tukey\_medium\_df <- as.data.frame(tukey\_medium)  
tukey\_interaction\_df <- as.data.frame(tukey\_interaction)  
  
# Add labels to indicate which factor the comparison refers to  
tukey\_day\_df <- tukey\_day\_df %>% mutate(factor = "Day")  
tukey\_medium\_df <- tukey\_medium\_df %>% mutate(factor = "Medium")  
tukey\_interaction\_df <- tukey\_interaction\_df %>% mutate(factor = "Interaction")  
  
all\_tukey\_df <- bind\_rows(tukey\_day\_df, tukey\_medium\_df, tukey\_interaction\_df)

all\_tukey\_df %>%  
 dplyr::select(factor, contrast, estimate, SE, df, t.ratio, p.value) %>%  
 gt() %>%  
 # change column names  
 cols\_label(  
 factor = "Comparison",  
 contrast = "Group Comparison",  
 estimate = "Estimate",  
 SE = "Standard Error",  
 df = "Degrees of Freedom",  
 t.ratio = "t-Ratio",  
 p.value = "p-value"  
 ) %>%  
 # update header for table  
 tab\_header(  
 title = "Emmeans Post-hoc Test Results"  
 ) %>%  
 # 3 decimal places  
 fmt\_number(  
 columns = c(estimate, SE, t.ratio),  
 decimals = 3  
 ) %>%  
 # scientific number format for values <0.001 in p values  
 fmt\_scientific(  
 columns = c(p.value),  
 decimals = 1,  
 rows = p.value < 0.001  
 ) %>%  
 # 3 decimals for p values >=0.001  
 fmt\_number(  
 columns = c(p.value),  
 decimals = 3,  
 rows = p.value >= 0.001  
 ) %>%  
 #make the headers bold  
 tab\_style(  
 style = list(  
 cell\_text(weight = "bold")  
 ),  
 locations = cells\_column\_labels(everything()))

Table 1: Emmeans Post-hoc Test Results

| Comparison | Group Comparison | Estimate | Standard Error | Degrees of Freedom | t-Ratio | p-value |
| --- | --- | --- | --- | --- | --- | --- |
| Day | day1 - day3 | 1.149 | 0.165 | 24 | 6.985 | 1.8 × 10^-6 |
| Day | day1 - day5 | 2.131 | 0.165 | 24 | 12.949 | 1.5 × 10^-11 |
| Day | day1 - day7 | 2.805 | 0.165 | 24 | 17.046 | 6.2 × 10^-14 |
| Day | day3 - day5 | 0.981 | 0.165 | 24 | 5.964 | 2.1 × 10^-5 |
| Day | day3 - day7 | 1.655 | 0.165 | 24 | 10.060 | 2.5 × 10^-9 |
| Day | day5 - day7 | 0.674 | 0.165 | 24 | 4.097 | 0.002 |
| Medium | (1%TB+AEbiofilm) - (MQ+AEbiofilm) | -2.932 | 0.142 | 24 | -20.579 | 2.1 × 10^-14 |
| Medium | (1%TB+AEbiofilm) - (PW+AEBiofilm) | -2.496 | 0.142 | 24 | -17.515 | 3.2 × 10^-14 |
| Medium | (MQ+AEbiofilm) - (PW+AEBiofilm) | 0.437 | 0.142 | 24 | 3.064 | 0.014 |
| Interaction | (day1 1%TB+AEbiofilm) - (day3 1%TB+AEbiofilm) | 2.045 | 0.285 | 24 | 7.176 | 1.1 × 10^-5 |
| Interaction | (day1 1%TB+AEbiofilm) - (day5 1%TB+AEbiofilm) | 2.092 | 0.285 | 24 | 7.340 | 7.8 × 10^-6 |
| Interaction | (day1 1%TB+AEbiofilm) - (day7 1%TB+AEbiofilm) | 1.994 | 0.285 | 24 | 6.997 | 1.7 × 10^-5 |
| Interaction | (day1 1%TB+AEbiofilm) - (day1 MQ+AEbiofilm) | -3.098 | 0.285 | 24 | -10.869 | 5.6 × 10^-9 |
| Interaction | (day1 1%TB+AEbiofilm) - (day3 MQ+AEbiofilm) | -1.988 | 0.285 | 24 | -6.974 | 1.8 × 10^-5 |
| Interaction | (day1 1%TB+AEbiofilm) - (day5 MQ+AEbiofilm) | -0.620 | 0.285 | 24 | -2.175 | 0.580 |
| Interaction | (day1 1%TB+AEbiofilm) - (day7 MQ+AEbiofilm) | 0.107 | 0.285 | 24 | 0.374 | 1.000 |
| Interaction | (day1 1%TB+AEbiofilm) - (day1 PW+AEBiofilm) | -2.296 | 0.285 | 24 | -8.056 | 1.6 × 10^-6 |
| Interaction | (day1 1%TB+AEbiofilm) - (day3 PW+AEBiofilm) | -2.003 | 0.285 | 24 | -7.028 | 1.6 × 10^-5 |
| Interaction | (day1 1%TB+AEbiofilm) - (day5 PW+AEBiofilm) | -0.474 | 0.285 | 24 | -1.662 | 0.868 |
| Interaction | (day1 1%TB+AEbiofilm) - (day7 PW+AEBiofilm) | 0.920 | 0.285 | 24 | 3.228 | 0.109 |
| Interaction | (day3 1%TB+AEbiofilm) - (day5 1%TB+AEbiofilm) | 0.047 | 0.285 | 24 | 0.164 | 1.000 |
| Interaction | (day3 1%TB+AEbiofilm) - (day7 1%TB+AEbiofilm) | -0.051 | 0.285 | 24 | -0.178 | 1.000 |
| Interaction | (day3 1%TB+AEbiofilm) - (day1 MQ+AEbiofilm) | -5.143 | 0.285 | 24 | -18.045 | 1.4 × 10^-13 |
| Interaction | (day3 1%TB+AEbiofilm) - (day3 MQ+AEbiofilm) | -4.033 | 0.285 | 24 | -14.150 | 2.3 × 10^-11 |
| Interaction | (day3 1%TB+AEbiofilm) - (day5 MQ+AEbiofilm) | -2.665 | 0.285 | 24 | -9.351 | 1.0 × 10^-7 |
| Interaction | (day3 1%TB+AEbiofilm) - (day7 MQ+AEbiofilm) | -1.938 | 0.285 | 24 | -6.802 | 2.7 × 10^-5 |
| Interaction | (day3 1%TB+AEbiofilm) - (day1 PW+AEBiofilm) | -4.341 | 0.285 | 24 | -15.232 | 4.7 × 10^-12 |
| Interaction | (day3 1%TB+AEbiofilm) - (day3 PW+AEBiofilm) | -4.048 | 0.285 | 24 | -14.203 | 2.1 × 10^-11 |
| Interaction | (day3 1%TB+AEbiofilm) - (day5 PW+AEBiofilm) | -2.518 | 0.285 | 24 | -8.837 | 3.0 × 10^-7 |
| Interaction | (day3 1%TB+AEbiofilm) - (day7 PW+AEBiofilm) | -1.125 | 0.285 | 24 | -3.948 | 0.023 |
| Interaction | (day5 1%TB+AEbiofilm) - (day7 1%TB+AEbiofilm) | -0.098 | 0.285 | 24 | -0.342 | 1.000 |
| Interaction | (day5 1%TB+AEbiofilm) - (day1 MQ+AEbiofilm) | -5.189 | 0.285 | 24 | -18.209 | 1.2 × 10^-13 |
| Interaction | (day5 1%TB+AEbiofilm) - (day3 MQ+AEbiofilm) | -4.079 | 0.285 | 24 | -14.314 | 1.8 × 10^-11 |
| Interaction | (day5 1%TB+AEbiofilm) - (day5 MQ+AEbiofilm) | -2.712 | 0.285 | 24 | -9.515 | 7.5 × 10^-8 |
| Interaction | (day5 1%TB+AEbiofilm) - (day7 MQ+AEbiofilm) | -1.985 | 0.285 | 24 | -6.966 | 1.8 × 10^-5 |
| Interaction | (day5 1%TB+AEbiofilm) - (day1 PW+AEBiofilm) | -4.388 | 0.285 | 24 | -15.396 | 3.7 × 10^-12 |
| Interaction | (day5 1%TB+AEbiofilm) - (day3 PW+AEBiofilm) | -4.095 | 0.285 | 24 | -14.368 | 1.6 × 10^-11 |
| Interaction | (day5 1%TB+AEbiofilm) - (day5 PW+AEBiofilm) | -2.565 | 0.285 | 24 | -9.001 | 2.1 × 10^-7 |
| Interaction | (day5 1%TB+AEbiofilm) - (day7 PW+AEBiofilm) | -1.172 | 0.285 | 24 | -4.112 | 0.016 |
| Interaction | (day7 1%TB+AEbiofilm) - (day1 MQ+AEbiofilm) | -5.092 | 0.285 | 24 | -17.867 | 1.7 × 10^-13 |
| Interaction | (day7 1%TB+AEbiofilm) - (day3 MQ+AEbiofilm) | -3.982 | 0.285 | 24 | -13.972 | 3.0 × 10^-11 |
| Interaction | (day7 1%TB+AEbiofilm) - (day5 MQ+AEbiofilm) | -2.614 | 0.285 | 24 | -9.172 | 1.5 × 10^-7 |
| Interaction | (day7 1%TB+AEbiofilm) - (day7 MQ+AEbiofilm) | -1.888 | 0.285 | 24 | -6.624 | 4.0 × 10^-5 |
| Interaction | (day7 1%TB+AEbiofilm) - (day1 PW+AEBiofilm) | -4.290 | 0.285 | 24 | -15.053 | 6.0 × 10^-12 |
| Interaction | (day7 1%TB+AEbiofilm) - (day3 PW+AEBiofilm) | -3.997 | 0.285 | 24 | -14.025 | 2.8 × 10^-11 |
| Interaction | (day7 1%TB+AEbiofilm) - (day5 PW+AEBiofilm) | -2.468 | 0.285 | 24 | -8.659 | 4.3 × 10^-7 |
| Interaction | (day7 1%TB+AEbiofilm) - (day7 PW+AEBiofilm) | -1.074 | 0.285 | 24 | -3.770 | 0.035 |
| Interaction | (day1 MQ+AEbiofilm) - (day3 MQ+AEbiofilm) | 1.110 | 0.285 | 24 | 3.895 | 0.026 |
| Interaction | (day1 MQ+AEbiofilm) - (day5 MQ+AEbiofilm) | 2.478 | 0.285 | 24 | 8.694 | 4.0 × 10^-7 |
| Interaction | (day1 MQ+AEbiofilm) - (day7 MQ+AEbiofilm) | 3.204 | 0.285 | 24 | 11.243 | 2.8 × 10^-9 |
| Interaction | (day1 MQ+AEbiofilm) - (day1 PW+AEBiofilm) | 0.802 | 0.285 | 24 | 2.813 | 0.235 |
| Interaction | (day1 MQ+AEbiofilm) - (day3 PW+AEBiofilm) | 1.095 | 0.285 | 24 | 3.842 | 0.030 |
| Interaction | (day1 MQ+AEbiofilm) - (day5 PW+AEBiofilm) | 2.624 | 0.285 | 24 | 9.208 | 1.4 × 10^-7 |
| Interaction | (day1 MQ+AEbiofilm) - (day7 PW+AEBiofilm) | 4.017 | 0.285 | 24 | 14.097 | 2.5 × 10^-11 |
| Interaction | (day3 MQ+AEbiofilm) - (day5 MQ+AEbiofilm) | 1.368 | 0.285 | 24 | 4.799 | 0.003 |
| Interaction | (day3 MQ+AEbiofilm) - (day7 MQ+AEbiofilm) | 2.094 | 0.285 | 24 | 7.348 | 7.6 × 10^-6 |
| Interaction | (day3 MQ+AEbiofilm) - (day1 PW+AEBiofilm) | -0.308 | 0.285 | 24 | -1.082 | 0.993 |
| Interaction | (day3 MQ+AEbiofilm) - (day3 PW+AEBiofilm) | -0.015 | 0.285 | 24 | -0.053 | 1.000 |
| Interaction | (day3 MQ+AEbiofilm) - (day5 PW+AEBiofilm) | 1.514 | 0.285 | 24 | 5.313 | 9.2 × 10^-4 |
| Interaction | (day3 MQ+AEbiofilm) - (day7 PW+AEBiofilm) | 2.907 | 0.285 | 24 | 10.202 | 1.9 × 10^-8 |
| Interaction | (day5 MQ+AEbiofilm) - (day7 MQ+AEbiofilm) | 0.726 | 0.285 | 24 | 2.549 | 0.359 |
| Interaction | (day5 MQ+AEbiofilm) - (day1 PW+AEBiofilm) | -1.676 | 0.285 | 24 | -5.881 | 2.3 × 10^-4 |
| Interaction | (day5 MQ+AEbiofilm) - (day3 PW+AEBiofilm) | -1.383 | 0.285 | 24 | -4.853 | 0.003 |
| Interaction | (day5 MQ+AEbiofilm) - (day5 PW+AEBiofilm) | 0.146 | 0.285 | 24 | 0.513 | 1.000 |
| Interaction | (day5 MQ+AEbiofilm) - (day7 PW+AEBiofilm) | 1.540 | 0.285 | 24 | 5.403 | 7.4 × 10^-4 |
| Interaction | (day7 MQ+AEbiofilm) - (day1 PW+AEBiofilm) | -2.402 | 0.285 | 24 | -8.430 | 7.0 × 10^-7 |
| Interaction | (day7 MQ+AEbiofilm) - (day3 PW+AEBiofilm) | -2.109 | 0.285 | 24 | -7.401 | 6.7 × 10^-6 |
| Interaction | (day7 MQ+AEbiofilm) - (day5 PW+AEBiofilm) | -0.580 | 0.285 | 24 | -2.035 | 0.668 |
| Interaction | (day7 MQ+AEbiofilm) - (day7 PW+AEBiofilm) | 0.813 | 0.285 | 24 | 2.854 | 0.219 |
| Interaction | (day1 PW+AEBiofilm) - (day3 PW+AEBiofilm) | 0.293 | 0.285 | 24 | 1.028 | 0.995 |
| Interaction | (day1 PW+AEBiofilm) - (day5 PW+AEBiofilm) | 1.822 | 0.285 | 24 | 6.395 | 6.9 × 10^-5 |
| Interaction | (day1 PW+AEBiofilm) - (day7 PW+AEBiofilm) | 3.216 | 0.285 | 24 | 11.284 | 2.6 × 10^-9 |
| Interaction | (day3 PW+AEBiofilm) - (day5 PW+AEBiofilm) | 1.529 | 0.285 | 24 | 5.366 | 8.1 × 10^-4 |
| Interaction | (day3 PW+AEBiofilm) - (day7 PW+AEBiofilm) | 2.923 | 0.285 | 24 | 10.255 | 1.8 × 10^-8 |
| Interaction | (day5 PW+AEBiofilm) - (day7 PW+AEBiofilm) | 1.393 | 0.285 | 24 | 4.889 | 0.003 |

# Big ol’ table TukeyHSD

tukey\_results <- TukeyHSD(mod1) # all days sig diff from each other, all media sig diff from each other  
  
# Convert Tukey HSD results to data frames  
tukey\_day <- as.data.frame(tukey\_results$day)  
tukey\_day$comparison <- rownames(tukey\_day)  
  
tukey\_medium <- as.data.frame(tukey\_results$medium)  
tukey\_medium$comparison <- rownames(tukey\_medium)  
  
tukey\_interaction <- as.data.frame(tukey\_results$`day:medium`)  
tukey\_interaction$comparison <- rownames(tukey\_interaction)  
  
# Combine all results into one data frame  
tukey\_combined <- rbind(  
 data.frame(tukey\_day, factor = "Day"),  
 data.frame(tukey\_medium, factor = "Medium"),  
 data.frame(tukey\_interaction, factor = "Interaction")  
)  
  
tukey\_combined <- tukey\_combined %>%  
 mutate(  
 diff = round(diff, 3),  
 lwr = round(lwr, 3),  
 upr = round(upr, 3)  
 )  
  
tukey\_combined %>%  
 dplyr::select(factor, comparison, diff, lwr, upr, p.adj) %>%  
 gt() %>%  
 cols\_label(  
 factor = "Comparison",  
 comparison = "Group Comparison",  
 diff = "Mean Diff",  
 lwr = "Lower CI",  
 upr = "Upper CI",  
 p.adj = "p-value"  
 ) %>%  
 tab\_header(  
 title = "Tukey HSD Post-hoc Test Results for AE Biofilm"  
 ) %>%   
 fmt\_number(  
 columns = c(p.adj),  
 decimals = 3,  
 rows = p.adj >= 0.001  
 ) %>%  
 fmt\_scientific(  
 columns = c(p.adj),  
 decimals = 1,  
 rows = p.adj < 0.001  
 )

Table 1: Tukey HSD Post-hoc Test Results for AE Biofilm

| Comparison | Group Comparison | Mean Diff | Lower CI | Upper CI | p-value |
| --- | --- | --- | --- | --- | --- |
| Day | 3-1 | -1.149 | -1.603 | -0.695 | 1.8 × 10^-6 |
| Day | 5-1 | -2.131 | -2.585 | -1.677 | 1.5 × 10^-11 |
| Day | 7-1 | -2.805 | -3.259 | -2.351 | 6.2 × 10^-14 |
| Day | 5-3 | -0.981 | -1.435 | -0.527 | 2.1 × 10^-5 |
| Day | 7-3 | -1.655 | -2.109 | -1.201 | 2.5 × 10^-9 |
| Day | 7-5 | -0.674 | -1.128 | -0.220 | 0.002 |
| Medium | MQ+AEbiofilm-1%TB+AEbiofilm | 2.932 | 2.576 | 3.288 | 2.1 × 10^-14 |
| Medium | PW+AEBiofilm-1%TB+AEbiofilm | 2.496 | 2.140 | 2.852 | 3.2 × 10^-14 |
| Medium | PW+AEBiofilm-MQ+AEbiofilm | -0.437 | -0.792 | -0.081 | 0.014 |
| Interaction | 3:1%TB+AEbiofilm-1:1%TB+AEbiofilm | -2.045 | -3.072 | -1.017 | 1.1 × 10^-5 |
| Interaction | 5:1%TB+AEbiofilm-1:1%TB+AEbiofilm | -2.092 | -3.119 | -1.064 | 7.8 × 10^-6 |
| Interaction | 7:1%TB+AEbiofilm-1:1%TB+AEbiofilm | -1.994 | -3.022 | -0.967 | 1.7 × 10^-5 |
| Interaction | 1:MQ+AEbiofilm-1:1%TB+AEbiofilm | 3.098 | 2.070 | 4.125 | 5.6 × 10^-9 |
| Interaction | 3:MQ+AEbiofilm-1:1%TB+AEbiofilm | 1.988 | 0.960 | 3.015 | 1.8 × 10^-5 |
| Interaction | 5:MQ+AEbiofilm-1:1%TB+AEbiofilm | 0.620 | -0.408 | 1.647 | 0.580 |
| Interaction | 7:MQ+AEbiofilm-1:1%TB+AEbiofilm | -0.107 | -1.134 | 0.921 | 1.000 |
| Interaction | 1:PW+AEBiofilm-1:1%TB+AEbiofilm | 2.296 | 1.268 | 3.323 | 1.6 × 10^-6 |
| Interaction | 3:PW+AEBiofilm-1:1%TB+AEbiofilm | 2.003 | 0.975 | 3.030 | 1.6 × 10^-5 |
| Interaction | 5:PW+AEBiofilm-1:1%TB+AEbiofilm | 0.474 | -0.554 | 1.501 | 0.868 |
| Interaction | 7:PW+AEBiofilm-1:1%TB+AEbiofilm | -0.920 | -1.947 | 0.108 | 0.109 |
| Interaction | 5:1%TB+AEbiofilm-3:1%TB+AEbiofilm | -0.047 | -1.074 | 0.981 | 1.000 |
| Interaction | 7:1%TB+AEbiofilm-3:1%TB+AEbiofilm | 0.051 | -0.977 | 1.078 | 1.000 |
| Interaction | 1:MQ+AEbiofilm-3:1%TB+AEbiofilm | 5.143 | 4.115 | 6.170 | 1.4 × 10^-13 |
| Interaction | 3:MQ+AEbiofilm-3:1%TB+AEbiofilm | 4.033 | 3.005 | 5.060 | 2.3 × 10^-11 |
| Interaction | 5:MQ+AEbiofilm-3:1%TB+AEbiofilm | 2.665 | 1.637 | 3.692 | 1.0 × 10^-7 |
| Interaction | 7:MQ+AEbiofilm-3:1%TB+AEbiofilm | 1.938 | 0.911 | 2.966 | 2.7 × 10^-5 |
| Interaction | 1:PW+AEBiofilm-3:1%TB+AEbiofilm | 4.341 | 3.313 | 5.368 | 4.7 × 10^-12 |
| Interaction | 3:PW+AEBiofilm-3:1%TB+AEbiofilm | 4.048 | 3.020 | 5.075 | 2.1 × 10^-11 |
| Interaction | 5:PW+AEBiofilm-3:1%TB+AEbiofilm | 2.518 | 1.491 | 3.546 | 3.0 × 10^-7 |
| Interaction | 7:PW+AEBiofilm-3:1%TB+AEbiofilm | 1.125 | 0.098 | 2.153 | 0.023 |
| Interaction | 7:1%TB+AEbiofilm-5:1%TB+AEbiofilm | 0.098 | -0.930 | 1.125 | 1.000 |
| Interaction | 1:MQ+AEbiofilm-5:1%TB+AEbiofilm | 5.189 | 4.162 | 6.217 | 1.2 × 10^-13 |
| Interaction | 3:MQ+AEbiofilm-5:1%TB+AEbiofilm | 4.079 | 3.052 | 5.107 | 1.8 × 10^-11 |
| Interaction | 5:MQ+AEbiofilm-5:1%TB+AEbiofilm | 2.712 | 1.684 | 3.739 | 7.5 × 10^-8 |
| Interaction | 7:MQ+AEbiofilm-5:1%TB+AEbiofilm | 1.985 | 0.958 | 3.013 | 1.8 × 10^-5 |
| Interaction | 1:PW+AEBiofilm-5:1%TB+AEbiofilm | 4.388 | 3.360 | 5.415 | 3.7 × 10^-12 |
| Interaction | 3:PW+AEBiofilm-5:1%TB+AEbiofilm | 4.095 | 3.067 | 5.122 | 1.6 × 10^-11 |
| Interaction | 5:PW+AEBiofilm-5:1%TB+AEbiofilm | 2.565 | 1.538 | 3.593 | 2.1 × 10^-7 |
| Interaction | 7:PW+AEBiofilm-5:1%TB+AEbiofilm | 1.172 | 0.144 | 2.199 | 0.016 |
| Interaction | 1:MQ+AEbiofilm-7:1%TB+AEbiofilm | 5.092 | 4.064 | 6.119 | 1.7 × 10^-13 |
| Interaction | 3:MQ+AEbiofilm-7:1%TB+AEbiofilm | 3.982 | 2.954 | 5.009 | 3.0 × 10^-11 |
| Interaction | 5:MQ+AEbiofilm-7:1%TB+AEbiofilm | 2.614 | 1.586 | 3.642 | 1.5 × 10^-7 |
| Interaction | 7:MQ+AEbiofilm-7:1%TB+AEbiofilm | 1.888 | 0.860 | 2.915 | 4.0 × 10^-5 |
| Interaction | 1:PW+AEBiofilm-7:1%TB+AEbiofilm | 4.290 | 3.262 | 5.318 | 6.0 × 10^-12 |
| Interaction | 3:PW+AEBiofilm-7:1%TB+AEbiofilm | 3.997 | 2.969 | 5.025 | 2.8 × 10^-11 |
| Interaction | 5:PW+AEBiofilm-7:1%TB+AEbiofilm | 2.468 | 1.440 | 3.495 | 4.3 × 10^-7 |
| Interaction | 7:PW+AEBiofilm-7:1%TB+AEbiofilm | 1.074 | 0.047 | 2.102 | 0.035 |
| Interaction | 3:MQ+AEbiofilm-1:MQ+AEbiofilm | -1.110 | -2.138 | -0.082 | 0.026 |
| Interaction | 5:MQ+AEbiofilm-1:MQ+AEbiofilm | -2.478 | -3.505 | -1.450 | 4.0 × 10^-7 |
| Interaction | 7:MQ+AEbiofilm-1:MQ+AEbiofilm | -3.204 | -4.232 | -2.177 | 2.8 × 10^-9 |
| Interaction | 1:PW+AEBiofilm-1:MQ+AEbiofilm | -0.802 | -1.829 | 0.226 | 0.235 |
| Interaction | 3:PW+AEBiofilm-1:MQ+AEbiofilm | -1.095 | -2.122 | -0.067 | 0.030 |
| Interaction | 5:PW+AEBiofilm-1:MQ+AEbiofilm | -2.624 | -3.652 | -1.597 | 1.4 × 10^-7 |
| Interaction | 7:PW+AEBiofilm-1:MQ+AEbiofilm | -4.017 | -5.045 | -2.990 | 2.5 × 10^-11 |
| Interaction | 5:MQ+AEbiofilm-3:MQ+AEbiofilm | -1.368 | -2.395 | -0.340 | 0.003 |
| Interaction | 7:MQ+AEbiofilm-3:MQ+AEbiofilm | -2.094 | -3.122 | -1.067 | 7.6 × 10^-6 |
| Interaction | 1:PW+AEBiofilm-3:MQ+AEbiofilm | 0.308 | -0.719 | 1.336 | 0.993 |
| Interaction | 3:PW+AEBiofilm-3:MQ+AEbiofilm | 0.015 | -1.012 | 1.043 | 1.000 |
| Interaction | 5:PW+AEBiofilm-3:MQ+AEbiofilm | -1.514 | -2.542 | -0.487 | 9.2 × 10^-4 |
| Interaction | 7:PW+AEBiofilm-3:MQ+AEbiofilm | -2.907 | -3.935 | -1.880 | 1.9 × 10^-8 |
| Interaction | 7:MQ+AEbiofilm-5:MQ+AEbiofilm | -0.726 | -1.754 | 0.301 | 0.359 |
| Interaction | 1:PW+AEBiofilm-5:MQ+AEbiofilm | 1.676 | 0.648 | 2.704 | 2.3 × 10^-4 |
| Interaction | 3:PW+AEBiofilm-5:MQ+AEbiofilm | 1.383 | 0.355 | 2.411 | 0.003 |
| Interaction | 5:PW+AEBiofilm-5:MQ+AEbiofilm | -0.146 | -1.174 | 0.881 | 1.000 |
| Interaction | 7:PW+AEBiofilm-5:MQ+AEbiofilm | -1.540 | -2.567 | -0.512 | 7.4 × 10^-4 |
| Interaction | 1:PW+AEBiofilm-7:MQ+AEbiofilm | 2.402 | 1.375 | 3.430 | 7.0 × 10^-7 |
| Interaction | 3:PW+AEBiofilm-7:MQ+AEbiofilm | 2.109 | 1.082 | 3.137 | 6.7 × 10^-6 |
| Interaction | 5:PW+AEBiofilm-7:MQ+AEbiofilm | 0.580 | -0.448 | 1.608 | 0.668 |
| Interaction | 7:PW+AEBiofilm-7:MQ+AEbiofilm | -0.813 | -1.841 | 0.214 | 0.219 |
| Interaction | 3:PW+AEBiofilm-1:PW+AEBiofilm | -0.293 | -1.321 | 0.734 | 0.995 |
| Interaction | 5:PW+AEBiofilm-1:PW+AEBiofilm | -1.822 | -2.850 | -0.795 | 6.9 × 10^-5 |
| Interaction | 7:PW+AEBiofilm-1:PW+AEBiofilm | -3.216 | -4.243 | -2.188 | 2.6 × 10^-9 |
| Interaction | 5:PW+AEBiofilm-3:PW+AEBiofilm | -1.529 | -2.557 | -0.502 | 8.1 × 10^-4 |
| Interaction | 7:PW+AEBiofilm-3:PW+AEBiofilm | -2.923 | -3.950 | -1.895 | 1.8 × 10^-8 |
| Interaction | 7:PW+AEBiofilm-5:PW+AEBiofilm | -1.393 | -2.421 | -0.366 | 0.003 |