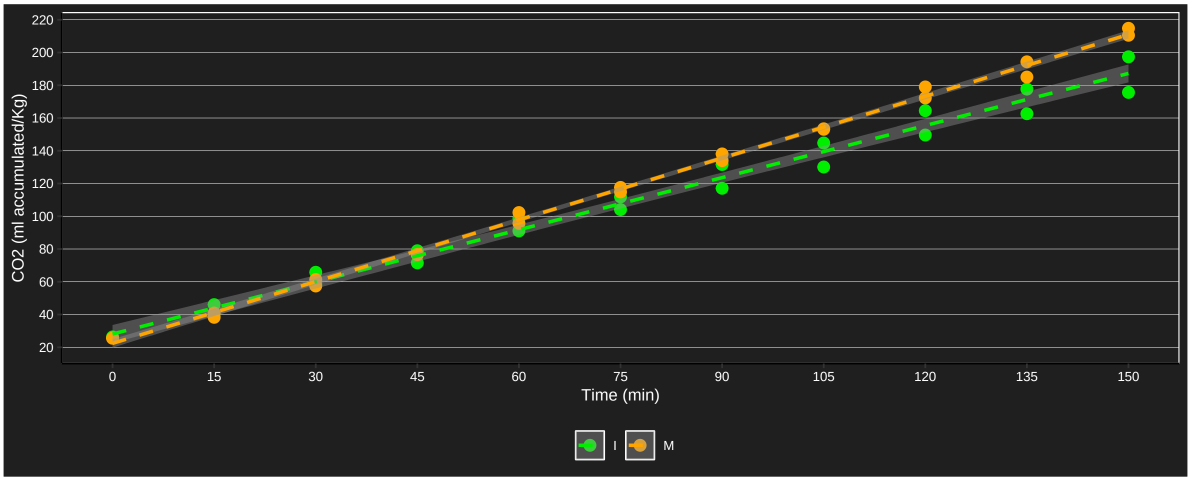
Respiration essay in Hexachlamys edulis

Figure 1: A caption

Immature and mature ubajay fruits were selected and randomly distributed in 4 jars, 2 immature and 2 mature, then respiration was quantified from accumulated CO_2 every 15 minutes for 150 minutes.

CO2 acumulation



Descriptive table

```
## # A tibble: 20 x 7
## # Groups:   time_min [10]
##    time_min matu  carbon_ac_n carbon_ac_Mean carbon_ac_sd carbon_ac_min carbon_ac_max
##    <fct>    <fct>       <int>          <dbl>        <dbl>         <dbl>         <dbl>
##  1 15       I               2           42.5        4.97           39.0          46.1
##  2 15       M               2           39.6        1.86           38.3          40.9
##  3 30       I               2           62.2        5.13           58.5          65.8
##  4 30       M               2           59.4        2.79           57.4          61.4
##  5 45       I               2           75.2        5.23           71.5          78.9
##  6 45       M               2           76.6        0.110          76.6          76.7
##  7 60       I               2           94.9        5.39           91.1          98.7
##  8 60       M               2           99.0        4.66           95.7         102.
##  9 75       I               2          108.         5.50          104.          112.
## 10 75       M               2          116.         1.97          115.          118.
## 11 90       I               2          124.        10.3           117.          132.
## 12 90       M               2          136.         2.91          134.          138.
## 13 105      I               2          137.        10.4           130.          145.
## 14 105      M               2          153.         0.221         153.          153.
## 15 120      I               2          157.        10.5           150.          164.
## 16 120      M               2          176.         4.77          172.          179.
## 17 135      I               2          170.        10.6           163.          178.
## 18 135      M               2          190.         6.59          185.          194.
## 19 150      I               2          186.        15.4           176.          197.
## 20 150      M               2          213.         3.02          211.          215.
```

Correlations over time

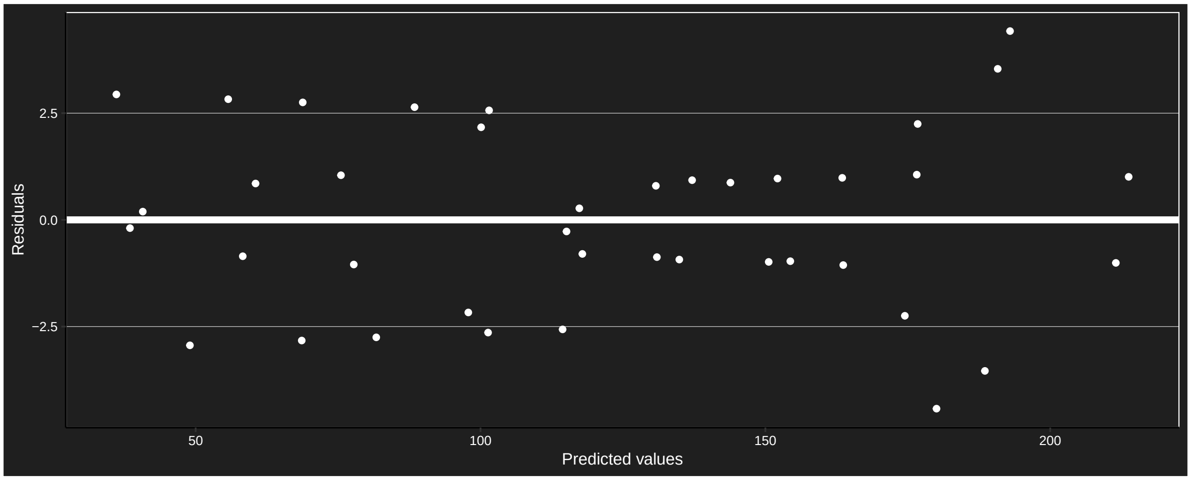
Covariance matrix

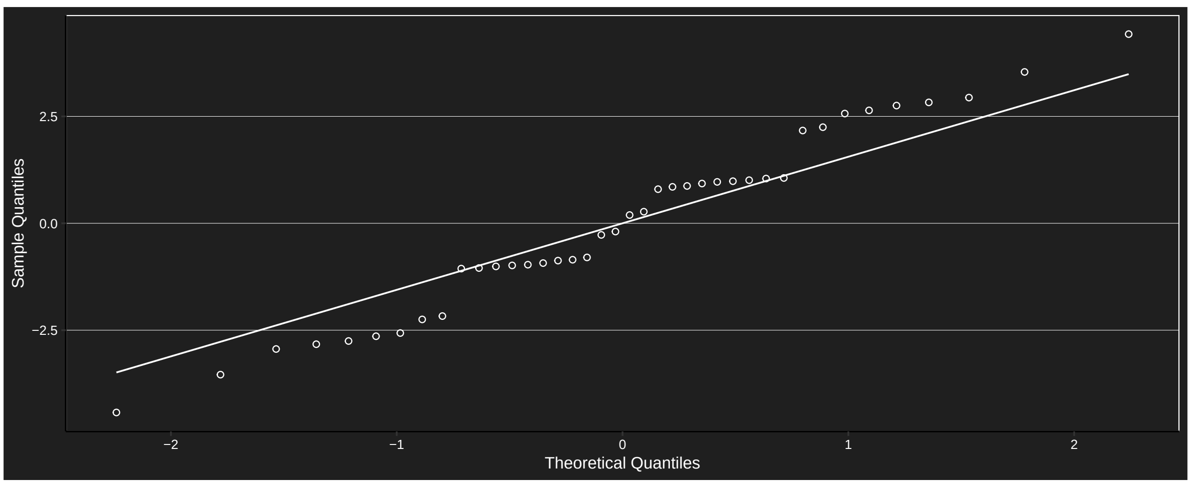
```
##         15    30    45    60     75     90    105    120    135    150
## 15   12.28 12.95  7.38  7.79   2.21   7.31   1.73   2.14   2.50   1.66
## 30   12.95 13.93  7.77  9.75   3.59   9.42   3.25   5.23   6.22   4.90
## 45    7.38  7.77  9.77 11.46  13.46  23.37  25.37  27.07  27.76  38.97
## 60    7.79  9.75 11.46 22.55  24.26  38.94  40.66  51.74  56.09  68.14
## 75    2.21  3.59 13.46 24.26  34.14  52.90  62.77  73.57  77.63 102.21
## 90    7.31  9.42 23.37 38.94  52.90  83.40  97.35 112.92 118.82 157.38
## 105   1.73  3.25 25.37 40.66  62.77  97.35 119.47 134.76 140.36 191.45
## 120   2.14  5.23 27.07 51.74  73.57 112.92 134.76 159.43 168.68 220.61
## 135   2.50  6.22 27.76 56.09  77.63 118.82 140.36 168.68 179.37 231.42
## 150   1.66  4.90 38.97 68.14 102.21 157.38 191.45 220.61 231.42 309.86
```

Marginal model with first-order autoregressive structure

```
## gls(model = (carbon_ac) ~ time_min * matu + basal, data = resp2w,
##     correlation = corAR1(form = ~1 | rep))
```

Assumptions






```
##
##  Shapiro-Wilk normality test
##
## data:  e
## W = 0.9761627, p-value = 0.549824
```

Model coefficients

```
##       (Intercept)        time_min30        time_min45        time_min60        time_min75        time
##   -1088.309859117      19.625054307      32.708423844      52.333478151      65.416847689       81.78
##       time_min150             matuM             basal  time_min30:matuM  time_min45:matuM  time_min6
##     143.954392798      24.020301930      43.217057762       0.171220178       4.327249699        7.05
## time_min120:matuM time_min135:matuM time_min150:matuM
##      21.518898568      22.485337162      29.098326710
```

Anova

```
## Denom. DF: 19
```

```
##               numDF     F-value p-value
## (Intercept)       1 12422.59816  <.0001
## time_min          9   497.67981  <.0001
## matu              1    23.52445  0.0001
## basal             1    18.30623  0.0004
## time_min:matu     9     4.64451  0.0024
```

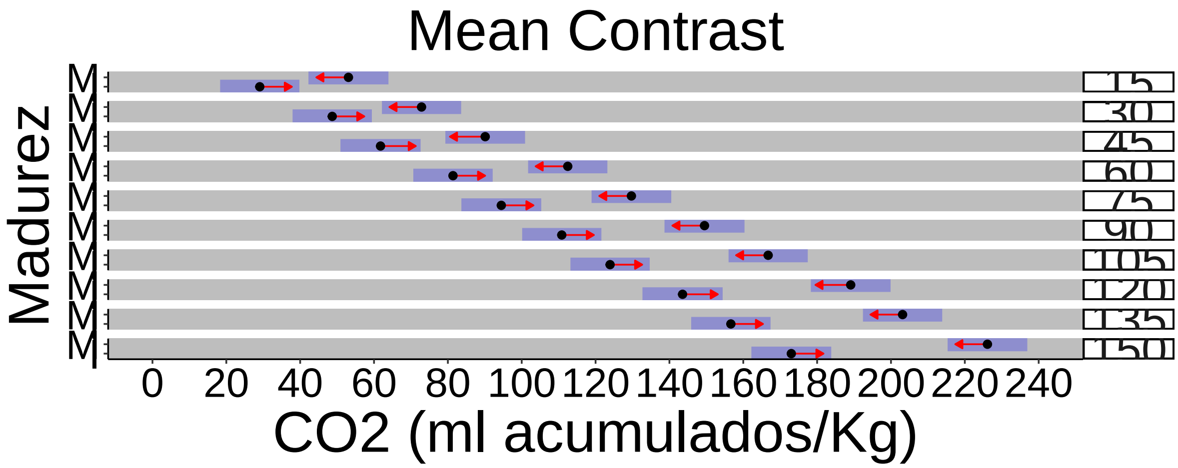
Simple effects

```
## $emmeans
## time_min = 15:
##  matu      emmean         SE   df    lower.CL    upper.CL
##  I     29.0559310 3.99641289 4.38  18.3274684  39.7843936
##  M     53.0762329 3.99641289 4.26  42.2426703  63.9097956
## 
## time_min = 30:
##  matu      emmean         SE   df    lower.CL    upper.CL
##  I     48.6809853 3.99641289 4.37  37.9473496  59.4146210
##  M     72.8725074 3.99641289 4.38  62.1474410  83.5975738
## 
## time_min = 45:
##  matu      emmean         SE   df    lower.CL    upper.CL
##  I     61.7643548 3.99641289 4.23  50.9066429  72.6220667
##  M     90.1119065 3.99641289 4.30  79.3151857 100.9086272
## 
## time_min = 60:
##  matu      emmean         SE   df    lower.CL    upper.CL
##  I     81.3894091 3.99641289 4.35  70.6412810  92.1375372
##  M    112.4650564 3.99641289 4.37 101.7314207 123.1986921
## 
## time_min = 75:
##  matu      emmean         SE   df    lower.CL    upper.CL
##  I     94.4727787 3.99641289 4.28  83.6565866 105.2889707
##  M    129.7044554 3.99641289 4.31 118.9126401 140.4962708
## 
## time_min = 90:
##  matu      emmean         SE   df    lower.CL    upper.CL
##  I    110.8456545 3.99641289 4.38 100.1171919 121.5741172
##  M    149.5007299 3.99641289 4.26 138.6671673 160.3342926
## 
## time_min = 105:
##  matu      emmean         SE   df    lower.CL    upper.CL
##  I    123.9290241 3.99641289 4.37 113.1953884 134.6626598
##  M    166.7401290 3.99641289 4.38 156.0150626 177.4651953
## 
## time_min = 120:
##  matu      emmean         SE   df    lower.CL    upper.CL
##  I    143.5540784 3.99641289 4.23 132.6963665 154.4117903
##  M    189.0932789 3.99641289 4.30 178.2965581 199.8899996
## 
## time_min = 135:
##  matu      emmean         SE   df    lower.CL    upper.CL
##  I    156.6374479 3.99641289 4.35 145.8893198 167.3855760
```

```
##  M    203.1430870 3.99641289 4.37 192.4094513 213.8767227
##
## time_min = 150:
##  matu      emmean         SE   df    lower.CL    upper.CL
##  I    173.0103238 3.99641289 4.28 162.1941317 183.8265159
##  M    226.1289524 3.99641289 4.31 215.3371371 236.9207678
##
## Degrees-of-freedom method: satterthwaite
## Results are given on the ( (not the response) scale.
## Confidence level used: 0.95
##
## $contrasts
## time_min = 15:
##  contrast    estimate         SE   df t.ratio p.value
##  I - M    -24.0203019 7.19762359 6.29  -3.337  0.0146
##
## time_min = 30:
##  contrast    estimate         SE   df t.ratio p.value
##  I - M    -24.1915221 7.19762359 6.30  -3.361  0.0141
##
## time_min = 45:
##  contrast    estimate         SE   df t.ratio p.value
##  I - M    -28.3475516 7.19762359 4.51  -3.938  0.0135
##
## time_min = 60:
##  contrast    estimate         SE   df t.ratio p.value
##  I - M    -31.0756472 7.19762359 6.28  -4.317  0.0045
##
## time_min = 75:
##  contrast    estimate         SE   df t.ratio p.value
##  I - M    -35.2316768 7.19762359 6.24  -4.895  0.0024
##
## time_min = 90:
##  contrast    estimate         SE   df t.ratio p.value
##  I - M    -38.6550754 7.19762359 6.29  -5.371  0.0015
##
## time_min = 105:
##  contrast    estimate         SE   df t.ratio p.value
##  I - M    -42.8111049 7.19762359 6.30  -5.948  0.0008
##
## time_min = 120:
##  contrast    estimate         SE   df t.ratio p.value
##  I - M    -45.5392005 7.19762359 4.51  -6.327  0.0021
##
## time_min = 135:
##  contrast    estimate         SE   df t.ratio p.value
##  I - M    -46.5056391 7.19762359 6.28  -6.461  0.0005
##
## time_min = 150:
##  contrast    estimate         SE   df t.ratio p.value
##  I - M    -53.1186286 7.19762359 6.24  -7.380  0.0003
##
## Note: contrasts are still on the ( scale
## Degrees-of-freedom method: satterthwaite
```

Statistically significant differences were found in the CO2 respiration rate in each time between immature and mature Hexachlamys edulis fruits.

Comparison chart



Fitted model plot