checking_nh4_dark

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What about NH4 Dark Condition?

We observe growth in the NH4 dark condition. Given that our highest growth rates are observed in the NH4 light condition, we should confirm that the growth observed in the dark is *not* an artefact of the experimental setup. In other words, how much time would the "dark" vials need to be erroneously left out in the light for us to observe the growth signature we do?

To get a sense for this problem, we use a model of isotopic incorporation:

$$F_T = a \cdot F_L \left(1 - e^{-\mu \cdot t}\right) + F_0 \cdot e^{-\mu \cdot t}$$

Where: - F_T is the fractional abundance of the heavy isotope at time t - a is the assimilation efficiency (assumed to be 0.5) - F_L is the fractional abundance isotopic composition of the label (1) - μ is the aggregate cell turnover rate - F_0 is the native isotopic composition of biomass (assumed to be natural abundance) - t is the duration of incubation

We need to find the *time* `t` required to reach an F_T observed in the NH_4 *dark* condition, assuming a growth rate μ that is identical to the light condition. For this test, we assume that μ of the dark condition is identical to the light condition because cells from both conditions should grow identically *before* being put in the incubation chamber.

We solve for t:

$$F_T = a \cdot F_L \left(1 - e^{-\mu \cdot t}\right) + F_0 \cdot e^{-\mu \cdot t} \downarrow t = \frac{-\frac{(F_T - a \cdot F_L)}{(F_0 - a \cdot F_L)}}{\mu}$$

Parameters: - F_T we compute the median isotopic enrichment of cells in the dark NH_4 condition (`0.03154381`) - F_0 we use natural ^{15}N abundance `.00364` - a we assume to be `0.5` - F_L we assume to be `1` (fully labeled)

Code

```
library(tidyverse)
roi_tbl <- read_tsv("roi_tbl_gentimes.tsv")

a = 0.5 # EDIT: assimilation efficiency
f_l =  1 # EDIT: Labeling strength as 15N frac abundance
t_d = 4 # labeling time in days
nat_abund_15N = .00364 # EDIT: Natural abundance of target isotope 15N frac abundance
f_0 = .00364 # EDIT: Initial Isotopic enrichment 15N frac abundance

# Find the median NH4 F_T at 96 hour incubation
nh4_tbl <- roi_tbl %>% filter(
  N_source == "NH4",
  light == "dark",
)
```

```
nh4_tbl <- nh4_tbl %>% filter(
  !is.na(Ratio_15N_12Cx14N_12C)
)

med_f_t_96 = median(nh4_tbl$Ratio_15N_12Cx14N_12C) # Median F_T

med_mu <- roi_tbl %>% filter(
  N_source == "NH4",
  light == "light",
  cell_type_other == "Picocystis"
)

med_mu <- med_mu %>% filter(
  !is.na(mu_d)
)

med_mu_96 = median(med_mu$mu_d)

median(med_mu$Ratio_15N_12Cx14N_12C)
```

```
## [1] 0.3862428
```

```
# calculate time required to reach F_T of observed dark condition given light condition growth params
t = - log((med_f_t_96 - a*f_l)/ (f_0-a*f_l)) / med_mu_96
```

Time in days required:

```
t
```

```
## [1] 0.1570898
```

Time in hours required:

```
t*24
```

```
## [1] 3.770154
```

So, it would take 3.7 hours of erroneous time in the light to reach the values we observe in the NH4 dark condition!