Mitochondrial succinate dehydrogenase enzyme activity in hibernating black bears

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Introduction

- Black bears suppress their metabolism by 75% during hibernation, 50% in spring emergence, and do not suppress metabolism in summer (2)
- During hibernation, black bears depress their body temperature to an average of 33°C (2)
- Metabolism suppression in hibernating bears is independent of temperature (2)
- Mitochondria are the main oxygen consumers for all eukaryotic cells and play a central role in metabolism
- Previous studies of liver mitochondria in hibernating ground squirrels have suggested inhibition of succinate dehydrogenase (SDH, complex II) plays a role in metabolic suppression (1)

Hypothesis

My hypothesis is that in kidney, cardiac, skeletal and liver tissue, SDH will be suppressed during hibernation and spring emergence compared to summer levels.

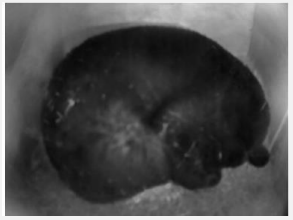

Fig. 1. Black bear hibernating in artificial den (Tøien et al. 2011)

Methods

Tissues were derived from UAF tissue bank, from black bears in different physiological stages (summer, hibernation, spring emergence)

Homogenized tissues in TrisHCl buffer, diluted to 1:10

Ran tissues in spectrophotometer with abs 600 nm w/cuvette temp. 37°C

Results

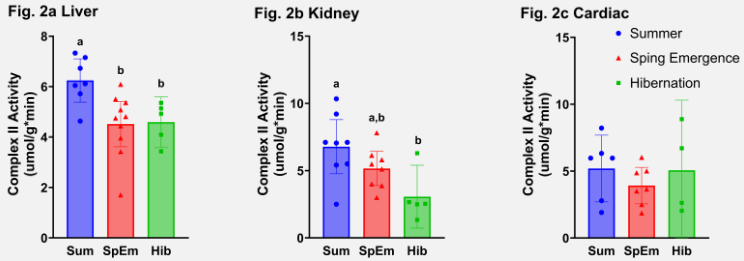

Fig. 2. SDH levels in liver, kidney, and cardiac tissue across all physiological states. 2a. Liver tissue showed lower SDH enzyme activity in spring emergence and hibernation compared to summer. 2b. Kidney tissue SDH enzyme activity was lower in hibernation compared to summer, but spring emergence did not significantly differ between groups. 2c. Cardiac tissue there was no significant difference across physiological states for SDH activity. Each dot represents SDH activity of a single individual, data shown are mean with 95% confidence interval, blue represents summer (Sum), red spring emergence (SpEm), green hibernation (Hib), n=5-10 per group. Activity rates are normalized to wet weight of tissue. Statistics are one-way ANOVA and posthoc Tukey. Letters represent significant differences between groups, $p<0.05$.

Results

- **Liver**- there is a similar decrease in SDH enzyme activity in hibernation and spring emergence compared to summer.
- **Kidney** - SDH activity was significantly lower in hibernation than summer, but spring emergence appeared to be in a less defined transitions state that did not significantly differ from summer or hibernation.
- **Cardiac** - showed no significant difference in SDH enzyme activity suppression across all physiological states.

Discussion

It appears in kidney and liver SDH activity follows a pattern with whole body metabolic suppression. While in cardiac tissue SDH activity does not seem to be suppressed with metabolic suppression. These results may indicate different regulation of mitochondria in different tissues across different metabolic stages in black bears.

Future Directions

- Continue analysis of SDH levels in skeletal tissue
- Normalize SDH activity to total protein concentration
- Measure concentration of SDH subunit protein levels in tissues

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