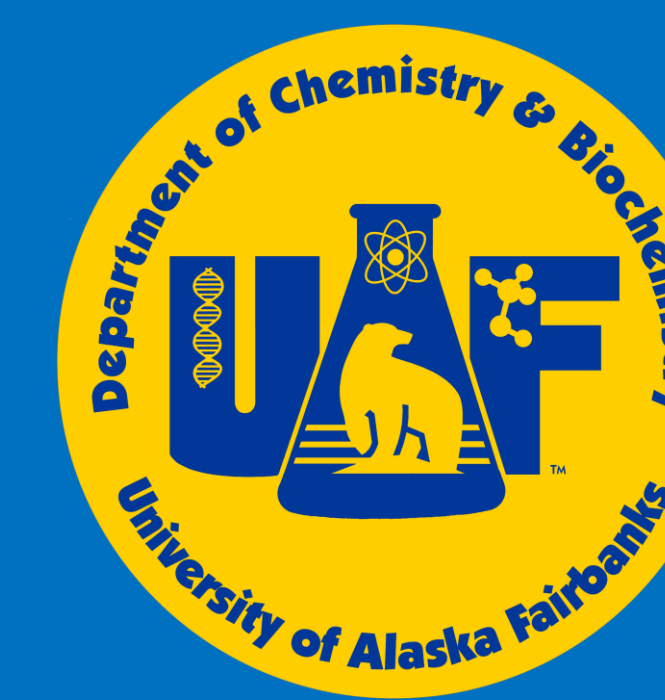


Mitochondrial succinate dehydrogenase enzyme activity in hibernating black bears

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Introduction

- During hibernation, black bears depress their basal body temperature (T_b) to an average of 33°C (1)
- Black bears suppress their metabolism (MR) by 75% during hibernation, 50% in spring emergence, and no MR suppression in summer (1)
- Therefore, MR suppression in hibernating black bears is independent of temperature
- Previous studies of liver mitochondria in hibernating ground squirrels have suggested inhibition of succinate dehydrogenase (SDH, complex II) plays a role in metabolic suppression (3)

Hypothesis

I anticipate in kidney, liver, and skeletal muscle homogenate and isolated mitochondria tissue, SDH activity in hibernation will be decreased. However, I expect in cardiac tissue there will be no decrease of SDH activity during hibernation

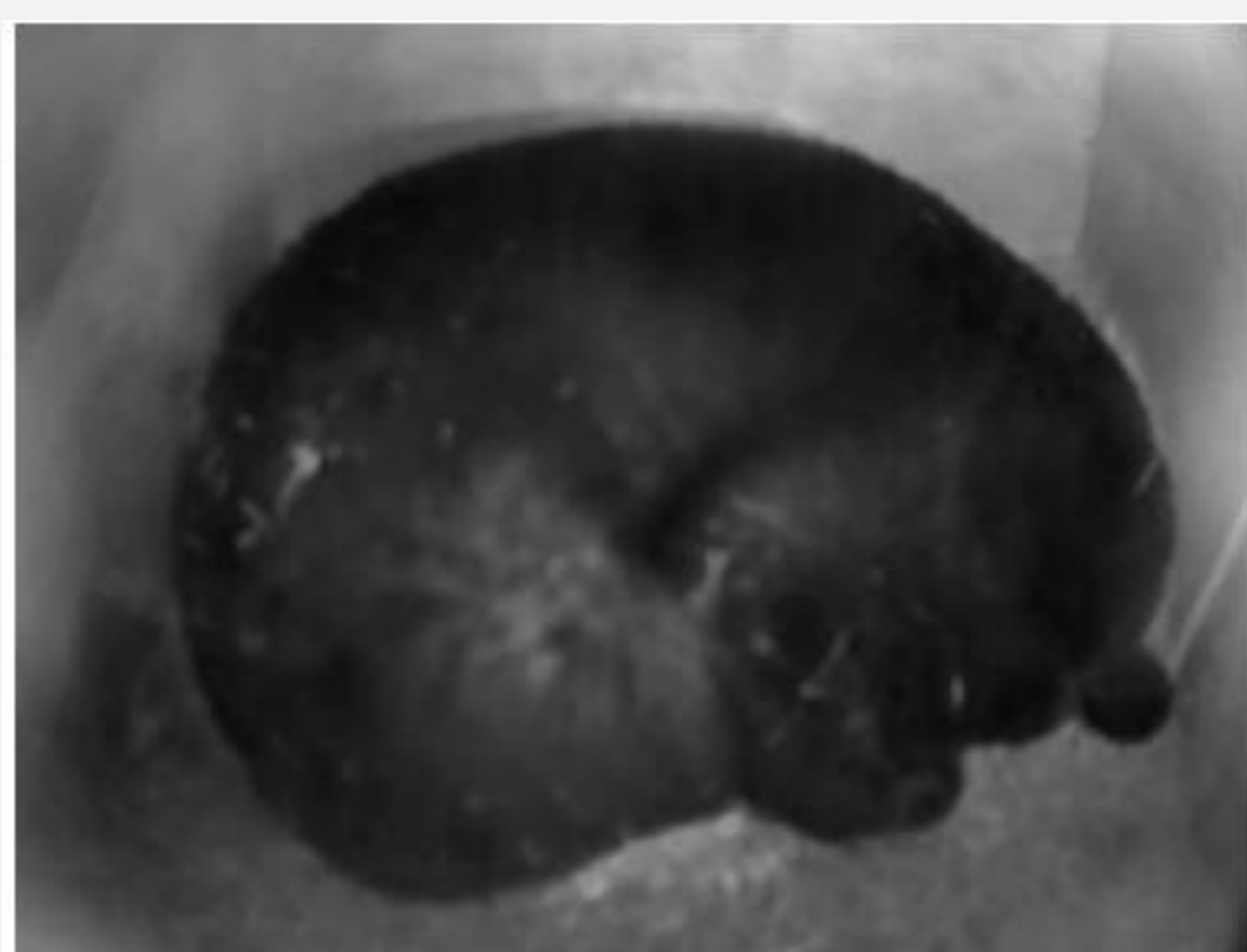
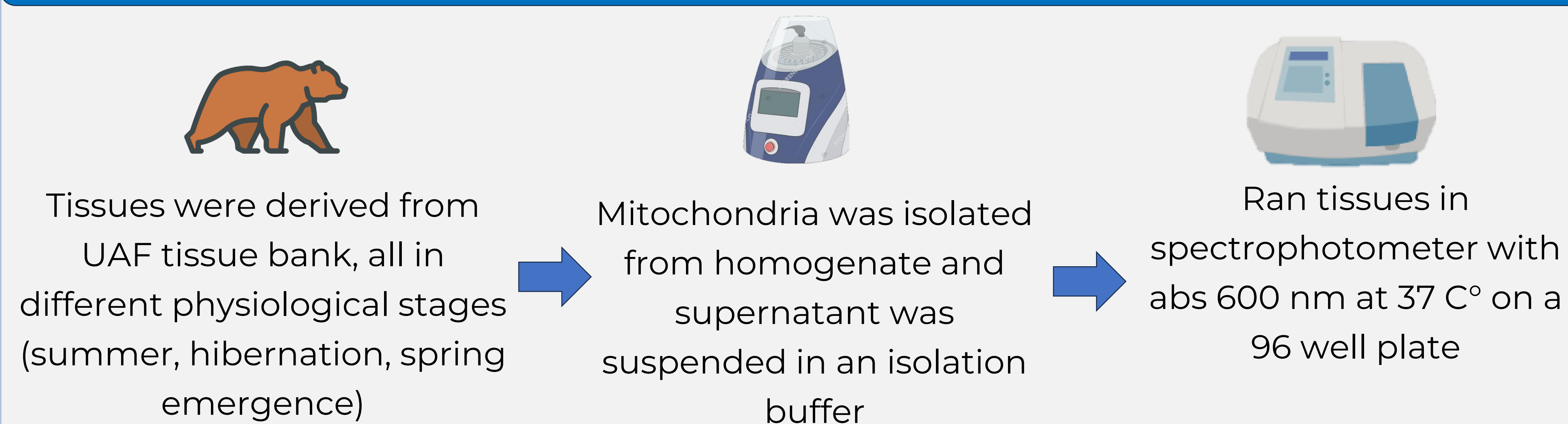


Fig. 1. Black bear hibernating in artificial den (Tøien et al. 2011)

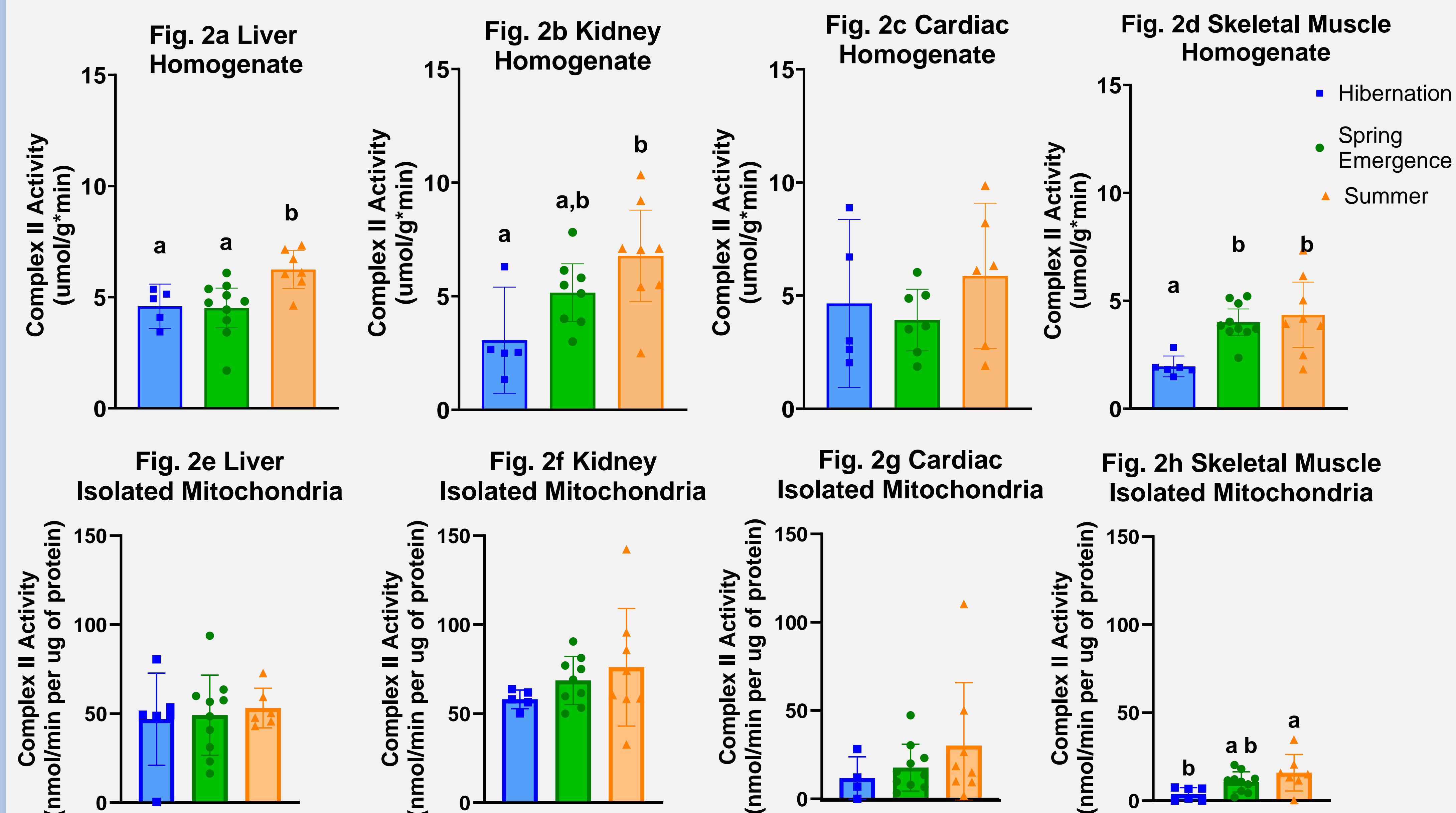
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Methods



Results



SDH activity is decreased in skeletal muscle homogenate and isolated mitochondria in hibernating black bears, while in liver and kidney homogenate SDH activity appears to decrease with whole body metabolic suppression, but not isolated mitochondria. Cardiac tissue shows no significant difference across physiological states

Fig. 2. SDH (complex II) activity in liver, kidney, cardiac and skeletal muscle across all physiological states in homogenate and isolated mitochondria. 2a. Homogenate liver tissue showed lower SDH activity in spring emergence and hibernation compared to summer. 2b. Homogenate kidney tissue SDH activity was lower in hibernation compared to summer, but spring emergence did not significantly differ between groups. 2c. Homogenate cardiac tissue had no significant difference across physiological states for SDH activity. 2d. Homogenate skeletal tissue SDH activity was decreased in hibernation compared to spring emergence and summer levels. 2e. Isolated mitochondria liver tissue had no significant difference across physiological states for SDH activity. 2f. Isolated mitochondria kidney tissue had no significant difference across physiological states for SDH activity. 2g. Isolated mitochondria cardiac tissue had no significant difference across physiological states for SDH activity. 2h. Isolated mitochondria skeletal muscle tissue shows lower SDH activity in hibernation compared to summer, but spring emergence did not significantly differ between groups. Each dot represents SDH activity of a single individual, data shown are mean with 95% confidence interval, blue represents hibernation (HIB), green spring emergence (SpEm), orange summer (Sum), n=5-10 per group. Fig. 2a-2d activity rates are normalized to wet weight of tissue. Fig 2d-2h were normalized to total protein. Statistics are one-way ANOVA, posthoc Tukey and Kruskal-Wallis test. Letters represent significant differences between groups, p<0.05.

Discussion

- Reduced SDH activity in liver and kidney homogenate, but not isolated mitochondria, could be due to decreased overall mitochondrial abundance in these hibernating tissues
- Decreased SDH activity in isolated skeletal muscle mitochondria during hibernation may potentially indicate an increase in active inhibition, reduced SDH protein content or post-translational modifications
- Unlike small animal hibernators, which exhibit reduced SDH activity in isolated liver and muscle mitochondria (3,4) black bears appear to only reduce isolated mitochondria SDH activity specifically within skeletal muscle
- This distinction demonstrates unique regulation of SDH in hibernating black bears compared to small animal hibernators.

Future Directions

- Measure SDH subunit protein concentration
- Continue analysis of enzyme activity in Complex IV
- Determine mitochondrial abundance in tissues

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