Award Details

Glucose metabolism in aquatic animals

Research Details

Competition Year:	2018	**Fiscal Year:**	2018-2019
Project Lead Name:	Driedzic, William	**Institution:**	Memorial University of Newfoundland
Department:	Ocean Sciences Centre	**Province:**	Newfoundland and Labrador
Award Amount:	33,000	**Installment:**	1 - 5
Program:	Discovery Grants Program - Individual	**Selection Committee:**	Biological Systems and Functions
Research Subject:	Animal physiology and metabolism	**Area of Application:**	Life sciences (including biotechnology)
Co-Researchers:	No Co-Researcher	**Partners:**	No Partners

Award Summary

Glucose metabolism has been studied in aquatic animals for over 100 years yet there remain important questions to be resolved. 1) Glucose metabolism in Atlantic cod gas gland. Many fish utilize a gas filled swim bladder to maintain neutral buoyancy. As fish dive pressure increases by 1 atm for every 10 m of depth. This causes the swim bladder to compress and in order to maintain buoyancy increased gas must be deposited. In most species the swim bladder is filled primarily with O2 via a gas gland that clusters around a network of blood vessels. The glandular cells generate H+ that causes O2 to unload from haemoglobin. H+ and O2 accumulate in the plasma and O2 moves by diffusion into the swim bladder. H+ is produced from anaerobic glycolysis with the production of lactic acid. There are many studies on the physiology and biochemistry of swim bladder and gas gland function but none have been conducted at pressures that occur in real life. The present experiments will address for the first time the biochemistry of gas deposition and glucose metabolism under physiologically relevant conditions. Novel experiments will be possible with the use of a newly constructed chamber that is capable of developing pressures of 300 atm with flow through water at controlled temperatures. Cod will be utilized since they have a discrete gas gland that is easy to harvest. Cod may travel between 50 and 275 m in 2 hr and may also occur at depths greater than 500 m. Work will focus on the first critical steps in glucose metabolism, i.e. transport into the cell via glucose transporter 1 and phosphorylation of glucose by hexokinase. The objectives of the program will be to assess the importance of glucose metabolism and control of the process in gas gland in animals undergoing normal pressure changes. 2) Is extracellular glucose required to maintain intracellular pH? Hearts from some species of fish (e.g. Armoured catfish, white sturgeon) are able to maintain intracellular pH at decreased extracellular pH allowing maintenance of contraction. The mechanisms of pH defense are unknown but likely involve Na+ exchange which places demands on Na+/K+ ATPase (NKA) to maintain Na+ balance. In mammalian heart, NKA is fueled primarily by glycolysis. In fish hearts, extracellular glucose is directed primarily if not exclusively to lactate production even under normal O2, suggesting a necessity for glycolysis consistent with fueling membrane ATPases. This leads to the hypothesis that anaerobic glycolysis is necessary to maintain pHi. Heart cells will be isolated from fish and exposed to low pHe with or without glucose in the medium. pHi, oxygen consumption, lactate production, and glucose metabolism will be tracked. This program will articulate roles of glucose metabolism that are specific to particular functions as opposed to being a general fuel source for ATP production. This will result in a paradigm shift with respect to how we think about the role of glucose.**********.**********