Assessing the impact of ionising radiation on bivalves


[1]

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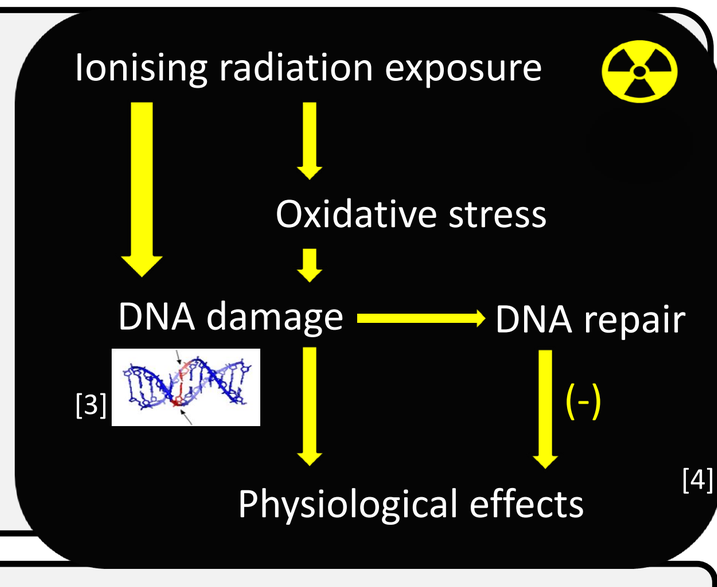
TREE Transfer - Exposure - Effects: RESEARCH WITH PLYMOUTH UNIVERSITY

BACKGROUND

- The aquatic environment is the main recipient of anthropogenic contaminants, including radionuclides
- Growing environmental and human health concern over the presence of radionuclides
- Aquatic organisms play an important role in ecosystem functioning, bivalve molluscs particularly important for several reasons **(a)** Economic value **(b)** Ecological role: Keystone species **(c)** Environmental biomarker – useful for environmental bio-monitoring[2]
- Genetic information (DNA) is an important target for the action of ionising radiation



AIMS

- To determine a range of biological responses in bivalve molluscs following exposure to a range of radionuclides of differing emission characteristics, either alone or in combination with additional environmental stressors
- Establish potential links between DNA damage and higher levels of biological organisation (i.e tissue, individual, germ cell and transgenerational effects)

OBJECTIVES

(1) Confirm the species to be used in the experiments using molecular techniques

(2) Quantify the induction of DNA damage and repair in different tissues using a range of techniques

(3) Determine the transcriptional expression of genes involved in DNA damage response (DDR) and stress response

(4) Determine histological and physiological effects. Establish potential links with DNA damage and molecular response

(5) Determine DNA damage in germ cells (i.e sperm) and correlate it with fertilisation success potential

APPROACH AND METHODOLOGY

Clearance rate (CR)

An estimation of the rate at which a bivalve molluscs filter water

Useful as a measurement of physiological effects – CR affected by environmental stressors[5]

DNA strand breaks in germ cells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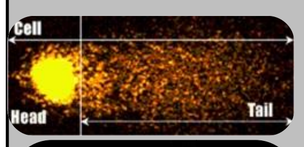
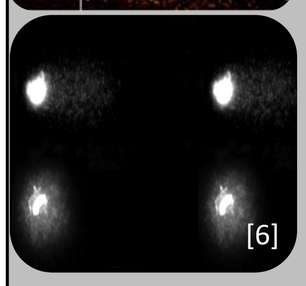
DNA damage at the development stages (germ cells i.e. sperm) can have potential long-term consequences for population success

(i.e fertilisation success, developmental abnormalities)[12]

DNA damage and repair

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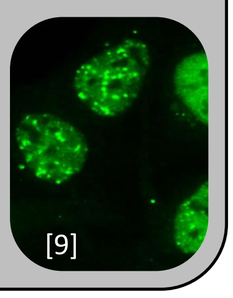
The **comet assay** (single-cell gel electrophoresis) - used to detect DNA strand breaks and repair in cells

Comet tail intensity corresponds to the amount of DNA damage

Immunocytochemical assays:

53BP1 induction[7] and γ-H2AX (key factors in the repair process of DNA)[8]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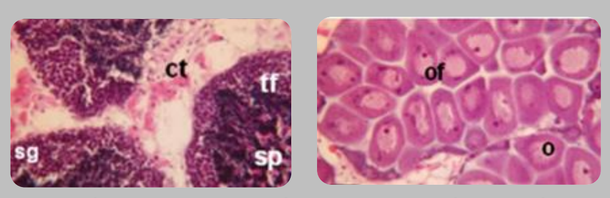
Histology

Light and electro-microscopic approach to study histological sections of mussel tissues



Light micrograph sections through male and female gonads (*M.edulis*)[10]

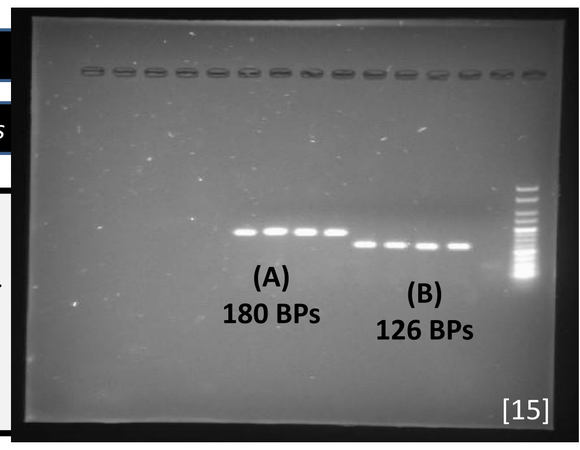
Transcriptional expression of genes

Investigation into the role of genes encoding proteins known to be involved in DDR and DNA repair.

Real-time PCR to quantify the expression levels of genes (inc. *p53*, *RAD* etc. and antioxidants e.g. superoxide distmutase, metallothionein etc.)[11]

A) M. edulis

B) M. Galloprovincialis



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CURRENT RESEARCH WORK

1. Identification and confirmation of mussel species using the Glu 5 gene as marker (PCR)[14]
2. Optimisation/validation of DDR in different tissues using comet assay and immunocytochemical assays

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References: (1) l-aquaculture.blogspot.com (2) Lonsdale *et al* (2009) *Aquatic Biology* 6(1-3), 263–279 (3) www.scientificamerican.com (4) Won *et al* (2014) *Env Sci Pol Res. (*5) Petersen *et al* (2004) Marine Ecology Progress Series 267, 187-194 (6) www.libyanjournalofmedicine.net & jhc.sagepub.com (7) Panier *et al* (2013) *Nature Reviews Molecular Cell Biology* 15, 7–18 (8) Srivastaca *et al* (2009) *Mutation research/Reviews in mutation research* 681, 180-188 (9) Human linfoid tissue labelling 53BP1 (www.abcam.com) (10) Sheir, *et al* (2013) *Arch Environ Contam Toxicol* 64, 701–716 (11) Farcy *et al* (2007) *Science of the Total Environment* 374, 328–341 (12) Lewis *et al* (2008), *Environ Sci Technol* 43, 928-933 (13) www.seagrant.umaine.edu (14) Inoue *et al* (1995), The Biological Bulletin 189(3), 370–375 (15) Mussel identification. Dr L Dallas. 2014.