IBERS Biology: Parasites and Drug Screening module: Screening for Drug Resistance in Parasites

Introduction

Parasites are all around us, you will be familiar with some parasites, like fleas and ticks that we find on our pets. However, many more parasites exist on our planet and can invade plants, animals and humans.

For a short, guided tour of parasites watch this TEDx talk by Prof. Jo Hamilton, a Parasitologist at Aberystwyth University (the slides she uses are also available in the Subject Snapshots section) https://www.youtube.com/watch?v=RdukUXDlYT4

The increased need to feed people on our planet has led to more intensive farming systems throughout the UK and worldwide. The regular treatment of animals with drugs to combat pathogens is now commonplace due to these demanding farming systems.

One of the most successful groups of animals on our planet are worms called nematodes (we sometimes call these roundworms). Some nematodes live freely in the environment, for example in the soil, and can be very beneficial but other nematode species infect plants and animals, including humans. Jo talks a little bit about human parasitic nematodes but parasitic nematode infections are also responsible for many debilitating livestock diseases such as gastrointestinal and respiratory disorders.

Since the 1960s, chemical drugs (anthelmintics) have provided effective control against parasitic nematodes in the farming industry and in veterinary and human medicine. Jo even talks about having to take one of these drugs (Ivermectin) right at the end of her talk, to cure her own nematode infection that she caught on honeymoon!

If a parasite is killed by the drug it is **susceptible** to the drug. If a parasite is not killed by a drug it is **resistant** to that drug. The growth in intensive farming systems has led to greater selection pressures for resistance to drugs to develop. Parasitic nematodes are starting to become resistant to all groups of drugs currently available to treat small ruminants, causing great global concern.

Scientists are keen to develop new tests for detecting parasitic infections and also for detecting parasite resistance to drugs. However, the development of molecular based tests is on-going and there are only two commercial vaccines against nematodes available, despite many years of research.

The development of new drugs to treat parasitic infections is a balance between the multi-million pound costs of developing new drugs and modifying existing drugs (which is a much cheaper option). The cost of starting new anti-nematode discovery programmes for pharmaceutical companies is very high risk; hence University research is regarded as vital in the fight against parasitic disease.

Understanding the relationship between parasites and the organisms they infect (their hosts), identifying drug targets and drug discovery are important aspects of the work that we do in the Parasitology and Epidemiology group in IBERS. You can find out more about us here https://www.aber.ac.uk/en/ibers/research-and-enterprise/research/research-groups/parasitology_epidemiology_group/

In this module, we will focus on exploring parasite resistance to drugs and sustainable drug development.

Overview

Parasites are infectious and that can make them very difficult to work with, so often scientists use organisms that are related to them but are easier to work with. We call these "model organisms".

In this module we will be using the free-living nematode *Panagrellus redivivus* as our model. This is a non-pathogenic nematode found naturally in many environments around the world, including the soil, rotting fruit and even in beer mats!

Thorough a series of related workshops and online learning materials we will use microscopy to explore what the nematode looks like (its phenotype) and its body structure. We will apply drug pressure to the nematodes to determine the resistance status of two strains of nematode. We will verify the resistance or susceptibility of these strains by exploring molecular biology techniques to extract the DNA from the nematodes and to amplify (makes lots of copies) of its DNA thought a technique called Polymerase Chain Reaction (PCR). The sequences generated will then be used carryout bioinformatics analyses to confirm whether the nematodes are resistant or susceptible to the drugs.

Learning outcomes

In this module you will:

1. Explore the use of different microscopes (Workshop 1, section 1)

2. Design an experiment to test for drug efficacy and find out how to extract DNA from tissue (Workshop 1, section 2)

3. Find out how to set up a Polymerase Chain Reaction (PCR) and DNA gel and recognise how results are generated (Workshop 2)

4. Conduct basic bioinformatics on your data (Workshop 3).

5. Optional: Learn how to write a mini research paper. As a nice optional conclusion to this module you might like to have a go a writing up a mini research paper. You could show this mini paper to your tutor (if you are going to university) or to your science teacher at school to demonstrate how you have been continuing your learning from home and preparing for the next phase of your studies. If you would like to do this, we will show you how in the "Writing up your mini research paper" and "Example paper" documents.