RNA interference investigated in nematodes

Andrea Hinas, a researcher at the Department of Cell and Molecular Biology at Uppsala University, has established Uppsala’s first complete nematode laboratory. It is now being used for her own group’s research as well as by other research teams.

The nematode C. elegans is an important model organism in molecular and cell biology. It is small (about one millimetre long), transparent and easy to grow and study. Andrea Hinas’ research team uses nematodes to investigate how cells communicate with each other via RNA molecules and how these molecules regulate gene expression through a phenomenon called RNA interference (RNAi). This has proved to be an important mechanism for regulating genes in most eukaryotes.

“Quite a lot is known about how the RNA molecules are processed and how they control protein levels in the cell. But it is still unclear how RNA is packaged, transported and taken up by cells. We want to learn more about these processes,” says Andrea Hinas.

RNA transport might be a way of cell-cell communication, similar to classical hormones. RNA molecules are found in the blood and other bodily fluids such as urine and breast milk. If taken up by other cells, these RNA molecules could influence gene expression in the recipient cells. To establish the significance of RNA transport in animal cells, the research team characterizes the various stages of RNA transport in the nematode. Among other things, they have been able to identify a number of proteins involved in RNA transport and RNA interference. These proteins are connected to vesicular transport, a process that is very well conserved between nematodes and humans.

“By identifying the proteins needed for RNA regulation and transport, and then studying where they are located and what other proteins they interact with, we can create a network of the proteins needed for these processes”, says Andrea Hinas.

In the long term, this knowledge may aid in the development of new RNA-based drugs. Their efficacy and specificity could enable a target mRNA to be silenced, thereby reducing the production of disease-related proteins. The major difficulty with RNA drugs is administration, in other words, getting them into the cells where they are needed. This is another reason we need to know more about transport pathways and their mechanisms. Today, RNA drugs for treating liver diseases appear most promising, as the liver is relatively accessible to lipid-coupled RNA molecules.

“The latest findings — and something we are looking at — concern how RNAi is involved in epigenetics. This is the interaction between heredity and the environment, and how information is transmitted from one generation to another. Among other things, we have found a protein that might function as a link between RNA transport and epigenetics. We are now going to investigate how it works and whether it binds RNA or DNA, for example,” says Andrea Hinas.

How genes are regulated by RNA, and how RNA ‘talks’ to the cell nucleus, might also help researchers answer questions about the influences of our ancestors’ lives, for example whether your metabolism is affected by what your grandfather ate. There are indications that this is the case, and Andrea Hinas wants to investigate that, too.

“That is what is so exciting about research! Nothing is a given, and no two days are ever the same. You are looking for answers all the time, but the questions change along the way. So you never quite know what questions you will be able to answer through your research. I have very much followed my inclinations, even if I have not always chosen the easy route,” says Andrea Hinas.