RNA research

# Laboratory of Ideas

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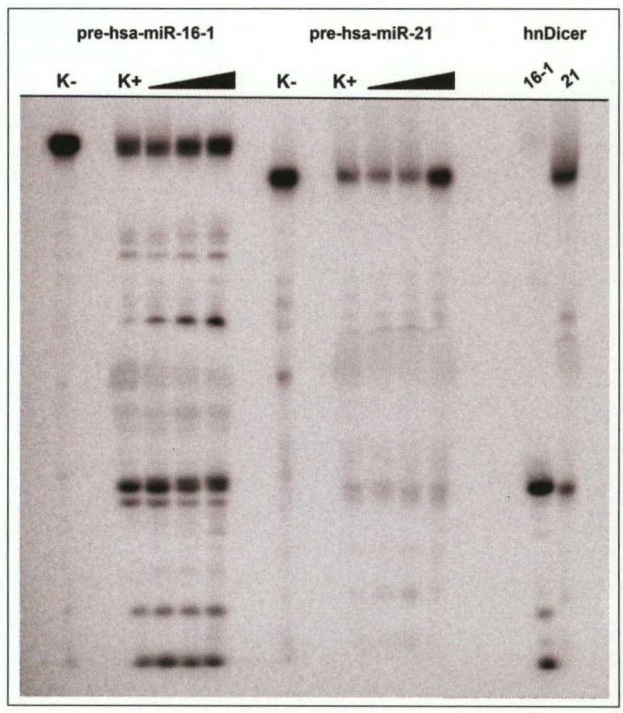
Dr. Anna Kurzyńska-Kokorniak dreams of forming her own fully-fledged research team. She is currently studying the specific regulation of maturation of miRNA moleculess

**To become successful in science, you need to fight for your ideas and secure funding to pursue them**

Reading the information encoded in the genomes of living organisms is one of the most important tasks faced by contemporary molecular biology and bioinformatics. There is no simple correlation between the size of a genome and the complexity of the organism; it is only in very simple organisms that the majority of the genome codes for proteins. In higher organisms, protein coding sequences constitute just a small part of the genetic material; in humans this is less than 5%. When the full human genome was published, it was revealed that - contrary to expectations - it did not contain 150,000 genes, but rather just 25,000; roughly the same number as the genome of *Arabidopsis thaliana*, a simple model plant. However, the real breakthrough in terms of the mechanisms regulating the expression of genetic information came more recently, mainly with the discovery of RNA interference (RNAi) and short regulatory RNA (earning the 2006 Nobel Prize in physiology and medicine for Fire and Mello). It has been shown that the genomes of eukaryotes, including humans, contain sequences encoding regulatory RNA molecules. Research conducted in the last decade clearly indicates that these molecules are one of the main factors regulating the expression of genetic information. In humans, a particularly important role is played by micro RNA molecules (miRNA). They control the expression of over 60% of protein-coding genes in human cells which, for instance play a key role in developmental processes, in the formation of specialized cells, tissues and organs, and in programmed cell death. There are growing numbers of reports showing that even small changes in the biogenesis or action of miRNA can result in many adverse processes (such as tumor formation, degeneration, and developmental abnormalities) leading to organ dysfunction and frequently death. Unfortunately we are currently almost entirely unable to counter these problems.

## On the RNA biogenesis trail

The way research work is organized across the globe, one needs to fight for one's own ideas and secure the necessary funding to pursue those ideas. In 2007, after I returned from a period working as a post-doc to Prof. Marek Figlerowicz's team at the PAS Institute of Bioorganic Chemistry in Poznań, I became involved in studies initiated by Prof. Figlerowicz concerning the recent and under-researched problem of the mechanisms responsible for miRNA formation and function. The results of preliminary studies revealed that we are able to influence the activity of enzymes involved in the miRNA biogenesis pathway. Two years later we obtained funding from the Ministry of Science and Higher Education to conduct our own research into whether RNA molecules act not only as substrates, but also as regulators of the




Author's archives

**We showed that the activity of one of the key enzymes involved in the miRNA biogenesis process - the Dicer ribonuclease - can be regulated by other RNA molecules that specifically bind to the enzyme**

activity of proteins involved in miRNA biogenesis. We showed that the activity of one of the key enzymes in the miRNA biogenesis process - the Dicer ribonuclease - can be regulated by other RNA molecules that specifically bind to the enzyme.

## New ideas

That project allowed us to formulate concepts for further studies. We observed that certain regulatory molecules influenced the formation of just a single miRNA molecule, while not having any effect on the maturation of other molecules. Design and production of compounds, that selectively target specific objects, e.g. tumor cells, particular enzymes or nucleic acid molecules, remain one of the most challenging issues of the biomedical field. Our results indicate that it is possible to design regulatory molecules which selectively control the maturation process and function of selected miRNA molecules. Using RNA oligomers that have a selective effect on the maturation and function of specific miRNA molecules paves the way for preparing novel therapeutic methods for the treatment of many diseases associated with deregulation of specific miRNA levels, like cancers, neurodegenerative diseases, and even infectious diseases.

## At home, at work, abroad

Back at home, I'm the mother of three children. When my daughter was two years old, I started working as a post-doc at Prof. Thomas Eickbush's laboratory at the Department of Biology, University of Rochester, New York, where I studied the mechanisms of expression and insertion of mobile genetic elements (retrotransposons). My husband and daughter joined me a few months later. After we returned home, I participated in an international research project involving obtaining and designing new HIV/AIDS therapeutics. In the meantime I became pregnant with my twin sons. The boys are now almost three years old, and when I get home, the little gang pounces on me - it makes me very happy, even though it can be exhausting!

One of my post-doc colleagues at Prof. Eickbush's lab, Shawn Christensen, specialized in studying interactions between proteins and nucleic acids. We had many a long discussion on the potential solutions to our research problems, cultural differences between Europe and the US, and why American food is so horrible. Christensen was recently appointed professor at the University of Texas at Arlington, and I got funding from the Foundation for Polish Science, through PARENT-BRIDGE Programme which supports parents who are scientists. This project is co-funded by European Union within European Regional Development Fund, and the funds I received help me conduct detailed studies into specific regulation of the process of maturation of miRNA molecules. The project will also involve a short working visit to Prof. Christensen's laboratory in Texas.

Author's archives

**Anna Kurzyńska-Kokorniak in her laboratory**

## Difficult returns

One of the advantages of scientific research is that it is not a 9-to-5 job, making it is easier to fit other duties around it. In between writing papers, cooking (my hobby!), preparing grant applications, and answering important questions such as why there are no dinosaurs alive these days, I am currently fighting in the Supreme Administrative Court on behalf of Polish scientists who work/worked under government grants at foreign universities, so they should not face a a tax horror-story when they decide to come back home! ■

**Further reading:**

Tyczewska A., Kurzyńska-Kokorniak A., Koralewska N., Szopa A., Kietrys A.M., Wrzesiński J., Twardowski T., Figlerowicz M. (2011). Selection of RNA Oligonucleotides That Can Modulate Human Dicer Activity In Vitro. *Nucleic Acid Therapeutics 21(5)*, 333-346.