Doubling the information from the Double Helix

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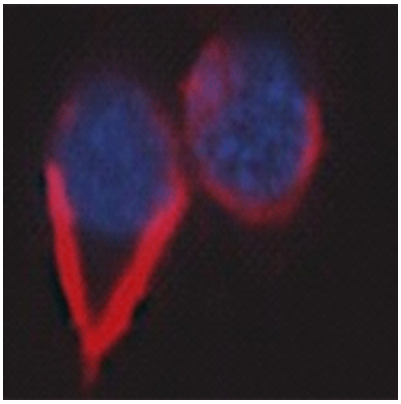

The mirror-miRNA (red) is expressed in hippocampal neurons, the nucleus is shown in blue.

(Phys.org) -- Our genes control many aspects of who we are — from the colour of our hair to our vulnerability to certain diseases — but how are the genes, and consequently the proteins they make themselves controlled? Researchers have discovered a new group of molecules which control some of the fundamental processes behind memory function and may hold the key to developing new therapies for treating neurodegenerative diseases.

The research, led by academics from the University of Bristol's Schools of Clinical Sciences, Biochemistry and Physiology & Pharmacology and published in the *Journal of Biological Chemistry*, has revealed a new

group of molecules, called mirror-microRNAs.

MicroRNAs are non-coding genes that often reside within 'junk DNA' and regulate the levels and functions of multiple target proteins — responsible for controlling cellular processes in the brain. The study's findings have shown that two microRNA genes with different functions can be produced from the same piece (sequence) of DNA — one is produced from the top strand and another from the bottom complementary 'mirror' strand.

Specifically, the research has shown that a single piece of human DNA gives rise to two fully processed microRNA genes that are expressed in the brain and have different and previously unknown functions. One microRNA is expressed in the parts of nerve cells that are known to control memory function and the other microRNA controls the processes that move protein cargos around nerve cells.

James Uney, Professor of Molecular Neuroscience in the University's School of Clinical Sciences, said: "These findings are important as they show that very small changes in microRNA genes will have a dramatic effect on brain function and may influence our memory function or likelihood of developing neurodegenerative diseases. These findings also suggest that many more human mirror microRNAs will be found and that they could ultimately be used as treatments for human neurodegenerative diseases such as dementia."

MicroRNAs can be seen as a novel regulatory layer within the genome, relying on the interaction between different RNA molecules. Through binding to messenger RNA (mRNA), they adjust the levels of proteins. Due to their small size, they are able to regulate many different RNAs. MicroRNAs have already been found throughout the double helix, lying in between genes or in areas of the code for a single gene that would normally be discarded. Such areas that were once considered

"junk DNA" are now revealing a more complex and important role. In addition microRNAs can be produced in conjunction with their genes, within which they lie, or be controlled and produced entirely independently.

Helen Scott and Joanna Howarth, the lead authors on the study, added: "We have now found that both sides of the double helix can each produce a microRNA. These two microRNAs are almost a perfect mirror of each other, but due to slight differences in their sequence, they regulate different sets of protein producing RNAs, which will in turn affect different biological functions. Such mirror-miRNAs are likely to represent a new group of microRNAs with complex roles in coordinating gene expression, doubling the capacity of regulation."

The double stranded DNA helix discovered by Watson and Crick holds all the information needed for life. Each strand of DNA is made up of a chain of units called bases. There are four different bases and it is the sequence of these bases that holds the information in sections called genes. Despite the sequence of the entire human genome now being known for ten years, scientists are still busy trying to make sense of all the information and understand the function of all the genes. For the information to be used, the sequence of DNA bases must be copied onto another molecule called RNA. Some RNAs are used to produce proteins, while other regulatory RNAs (called microRNAs) can control the production of multiple proteins. Together these RNAs regulate all biological functions.

More information: www.jbc.org/content/early/2012 … M111.326041.abstract

Provided by University of Bristol