

## New Research Rocks Base of Agbiotech

A paper published in June 2007 by a consortium of scientists from 80 research organisations has provided evidence that genes do not necessarily behave in a linear fashion with information flowing one way, from DNA to RNA to protein, as was thought till now. This central dogma that has been the bedrock of genetics and the foundation on which the genetic engineering industry is based, has been challenged by a growing collection of data but scientists have been reluctant to revise the scientific principles established by the Watson-Crick discovery of the structure of DNA and the subsequent understanding of gene function.

Now, unequivocal evidence comes from research organised by the US National Human Genome Research Institute, which has found that the human genome is not really a clear and organised set of genes but rather a tangle of overlapping, interacting genetic material that functions as a complex network, with highly nuanced gene regulation. Almost none of these mechanisms are understood. Not being able to predict how genes will behave strikes at the very basis of using genetic engineering as a tool to create new products. The biotechnology industry is built on the linear model of the "one gene, one protein" principle, postulated by scientists who created recombinant DNA in the 1970s. Earlier, it was thought that genes had clearly defined functions, therefore a gene from any organism could fit neatly and predictably into any other organism, however unrelated, and carry on its prescribed business. In this way, the Bt gene that produces a toxin in a soil bacterium is presumed to perform exactly the same function when inserted into cotton, or rice plants.

The new research shows that this assumption cannot be upheld. The use of genetic engineering to create new products rests on the presumption that there is a universal, genetic code that sets the rules for creating proteins from DNA and that the rules are virtually identical across all organisms. Even before this research on the human genome, the theory of a uniform system for making new proteins was challenged by a number of scientific discoveries like the presence of large amounts of 'junk DNA' in all organisms and the fact that the highly complex human organism was found to have just 30,000 genes, a fairly small number considering the myriad functions a human being performs.

The new research casts the spotlight on the role of 'junk DNA', the large amounts of DNA detected during genome sequencing for which no clear functions can be ascribed. It is now accepted that the so-called "junk" DNA has a key regulatory role and it is of critical importance in regulating gene expression in organisms, a process about which there is as yet little understanding.

Apart from the new evidence and the presence of junk DNA, there are other findings that challenge the one gene-one protein foundation of agricultural biotechnology. One of these is the discovery that DNA is not the sole hereditary material and not the only means of transmitting information for new protein synthesis.

Understanding of the Mad Cow Disease and its link with the human Jakob-Creutzfeldt disease shows that both diseases can be passed from generation to generation not via genes, but via a protein molecule called a 'prion'. Pioneering work done in the US by Stanley Prusiner, Susan Lindquist and Eric Kandel indicates that prions mediate a form of protein-based information flow, which seems to be important in a variety of biological processes. To all this, if we add what is being discovered about the other ways in which RNA acts and the process of RNA interference, the reliability of genetic engineering becomes questionable. RNA's normal role is to carry a message from the DNA to the cytoplasm where it provides the direction for making proteins. Now it appears that ordinary RNA can enter a cell, seek out a gene's protein making template and then destroy it. This process is called RNA interference.

A complex, interactive network of genetic material incorporating so-called 'junk DNA', prions as units of heredity and the phenomenon of RNA interference, invalidates the premise on which agricultural (and other) biotechnology has been founded. Evidence that gene expression is complex and non-linear begins to explain why so many things go wrong during the process of genetic engineering and why predicting its outcome remains a gamble. This opens up the question about the extent to which genetic engineering can be considered accurate and predictable as a 'manufacturing process'. What else is transmitted along with genes and how do these factors determine the outcome? How do genes actually function in the new environment and can one ever hope to control the complex regulatory mechanisms that come into play once a gene, or many genes, are engineered into another background?

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