appeared on 24th Oct 2006

Abracadabra in pharmacology

Language teachers have entered the field of practical microbiology, says S.Ananthanarayanan.

The journal ***Natur***e reports this week that the methods of linguistics may open the door to laboratory preparation of special agents to fight bacteria that resist conventional attacks.

Linguistics and variety

The different sounds that are available for us to utter as words can be used in virtually infinite permutations and combinations, even within the range of a few dozen syllables. While combinations of just a few sounds make for the words of a language, there is hardly any limit to the number of ways these words can be put together. Yet, the rules of grammar are able to select out of these countless possibilities and develop a consistent system of communication, in the form of a language.

Other instances

Another instance of great variety in ways to combine is in the 'letters' and 'words' of the genetic code. It is found that the DNA, or the molecule in the nucleus of every living cell and which contains the information to tell each cell how to behave, so that the code uniquely defines each individual living thing, consists of just 4 building blocks – bits of chemical strings, named A, G, C and T. Each '***triad***,' or threesome of these defines one of twenty different amino acids, which are the building blocks of proteins. And a string of thousands of these 'triads' lists out the sequence of amino acids that male up millions of different proteins, all spelt out by different 'combination keys' of the billion odd 'triads' in the DNA molecule.

A simpler instance of variety is the structure of simpler proteins, which are coded by a comparatively short string of genetic alphabet. Some of these simpler proteins, known as antimicrobial peptides (AmPs) are found to occur naturally in animals and have remarkable anti-microbial properties.

AmPs in the lab

In principle, as AmPs consist of a smaller number of units, all possible AmPs could be built, from scratch, in the lab – to try out which ones have useful therapeutic qualities. The trouble is that although AmPs are small, they still have hundreds or thousands of components and the number of combinations possible is still completely out of reach! The only chance is if AmPs have some simple basic structure, which eliminates the great bulk of the possible forms of peptide made from those amino acids, so that only a manageable number need to be tried out

Such a possibility was revealed in studying the reason for the antibacterial action of AmPs. It was found that AmPs have both a portion that has an electric charge, which attaches to water, as well as neutral portions, which do not. It is this portion that enables AmPs to attach to bacteria and then to enter and destroy. This is found to be a common structure of AmPs. And it is also seen that most AmPs also contain repeated modules of amino acid sequences, which seems to account for this feature.

Linguistics

Important topics in the field of linguistics, or the study of languages, are ***morphology***, which is the way sound combine to form words, and ***syntax***, the way words combine to form meaningful sentences. A child growing in the midst of a language soon learns the rules and is able to construct complex sentences with correct structure, all her own and which she has never heard before.

Thus, linguists work on the structure of different languages, to compare and contrast, or to develop systems to teach the languages, or to assist translation. And along with this work have arisen some complex statistical analyses and mathematical tools, which analyse the sounds and words in samples of languages to discern patterns and syntax, or rules of grammar.

Scientists of different disciplines, in MIT and the IBM labs in New York have made use of these same tools to analyse the sequences of amino acids in about 700 naturally occurring AmPs. The analyses have thrown up rules of how sequences of amino acids were disposed, a lot like the rule that a verb falls between 2 nouns in a sentence in English.

The scientists then synthesized new AmPs, with amino acids placed according to the rule and have found that they consistently showed antimicrobial ability, unlike different arrangements of the same amino acids.

The discovery is a useful tool in generating a new class of therapeutic agents, based on highly evolved structures present in the innate immune system of living things.

The 4 words, ‘Ram’, ‘reads’, ‘the’ and ‘book’ can be combined in 24 ways. But only 4 ways have a correct structure and 2 of them make sense.			
Ram reads the book	Reads Ram the book	the reads Ram book	book reads the Ram
Ram reads book the	Reads Ram book the	the reads book Ram	book reads Ram the

Ram the reads book	reads the Ram book	The Ram reads book	book the reads Ram
Ram the book reads	reads the book Ram	The Ram book reads	book the Ram reads
Ram book the reads	Reads book the Ram	t**he book Ram reads**	Book Ram the reads
Ram book reads the	reads book Ram the	**the book reads Ram**	book Ram reads the

Just as only some combination of words are 'legal' and
only some of even these make sense, only certain
combinations of amino acids can act as AmPs
Methods native to Linguistics have helped identify the
unique combinations of amino acids,
out of the myriads that are possible.