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Genetics and Dogs' Coats

The tiny gene has big multiplier effect, says S.Ananthanarayanan.

Genes are portions of the million-unit long DNA molecule, which encodes the genetic heritage of living things. Each such segment codes for a particular protein and proteins are what control the way our cells grow and act. The unique combination of genes in individuals then makes for the set of proteins that give the individual her unique height, skin, hair, her smile, her frown and all the ailments she is susceptible or resistant to.

The human genome, or genetic roadmap, consists of twenty three pairs of chromosomes, each of which is a DNA molecule, consisting of segments which make up the genes. Each segment can be thousands of units long and it is estimated that there are over 25,000 genes in all. Each gene controls the production of one protein and combination of proteins correspond to each feature of the whole - and hence the variety of races, body and personality types and individuals. Our capability, developed in recent decades, to separate and study, or even mould, fine detail of the DNA, is the field of genetic engineering – which, among other things, holds out the promise of controlling the roots of many genetic diseases.

To match this great capability that we have achieved, is the great complexity of the genetic maze. Practical features of organisms are controlled by a combination of far separated genes and tracing the relationship is no simple matter. The DNA molecule itself is of the dimensions of atoms and the operations of identifying and modifying sub-fractional portions of DNA involves complicated and ingenious methods. Every correlation of a gene with a body condition is then a milestone and the international community builds on pieces of the jigsaw that diverse groups assemble.

Dogs and genetics

Work reported in a recent paper in the journal, ***Science***, by a group of workers led by Edouard Cadieu, and Elaine Ostrander, both of the National Human Genome Research Institute in Bethesda, Maryland, has been hailed as an important step forward – they have zeroed in on just three genes in the genome, or genetic make-up of the dog, which controls the kind of hair, or coat that the dog will have. Dogs have long been the genetic researcher's friend in providing ample, carefully bred families, to study genetics and heredity at work. There are several ailments that are common to humans and dogs, including some cancers and studies on dogs have already yielded useful results in treating human conditions.

Study of such a controlled group of genetically related individuals provides a set of largely identical genomes, and the variations that are common to groups of individuals would stick out - which simplifies the task of identifying features of interest. The world's stock of carefully developed breeds of dogs is thus a valuable genetic laboratory. A similar feature has been noted in communities like Jews or Parsees, and there has been some success in such human surveys. But the dogs are numerous, are grouped in breeds and they reproduce rapidly. They are thus often more convenient for research.

Elaine Ostrander and group examined the DNA of a thousand dogs of eighty breeds in a study sponsored by the National Institutes of Health, USA's leading medical research agency. The dog, after it parted ways with its ancestor, the wolf, has been subjected to extensive and varied breeding practices. The result is that the variety of breeds in dogs is unmatched in any other species and in the case of dogs, there is usually a reliable record of how the breed developed, as also collections of pure strains in pedigreed dogs. There are thus good numbers of animals with a common genetic pool, for fruitful study of genetic links to diseases that are common to particular breeds.

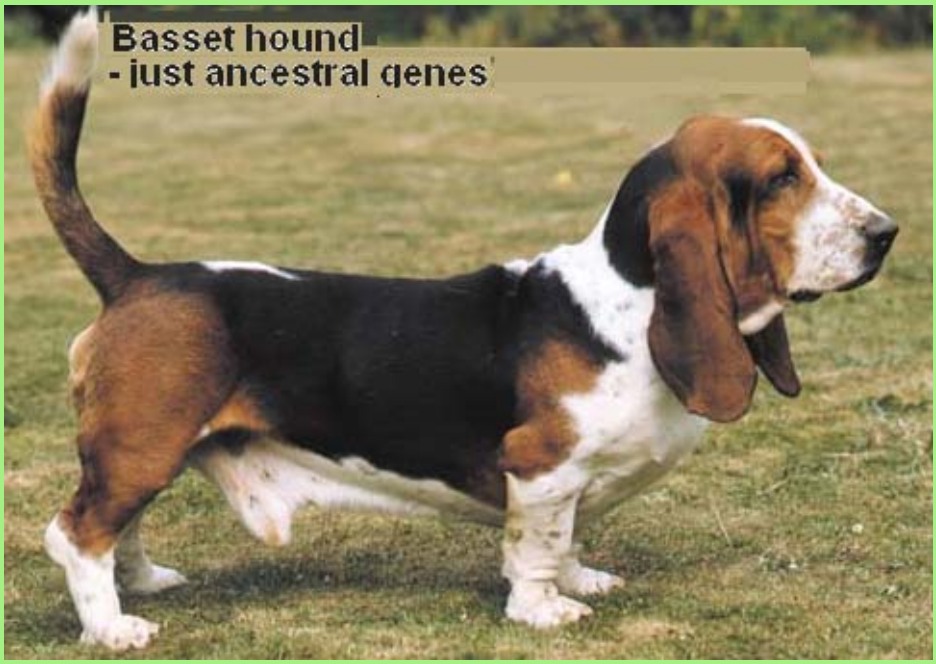
But major success in identifying a manageable number of genes that clearly code for a particular illness or other feature has been elusive.

Genes and hair type

The result reported by Ostrander and others is that they have identified just three genes that determine what kind of hair a dog would have. There are any number of genes that control related conditions in the development of hair, nails, keratin, and so on, which all dogs have. But the group has identified the specific genes that control how the whole hair process results in one of the seven main types of hair seen in pedigree dogs.

These hair types are simple, short hair, wiry hair, wiry and curly hair and long hair or curly hair, with or without additional features like beards. The study shows that all pure bred dogs have the three kinds of genes – all of which were inherited from the wolf, 15,000 years ago. These genes are: FGF5, which decides whether the hair is long or short, KRT71, whether it is curly or wavy and RSPO2 whether there are moustaches and large eyebrows, which are called 'furnishings'.

Dogs that have just the genes inherited from wolves have short hair, like the basset hound.



If there is variant form of only the RSPO2 gene, the dog has wiry hair, like the terrier. If the KRT71 is also a variant, the dog has curly and wiry hair. A variant of FGF5 results in long and silky hair, like the cocker spaniel. Dogs with variants of all three genes have long curly coats, with furnishings.

Gordon Lark, a biologist from the University of Utah says the genes involved in determining dog coat types are more interesting in the sense that they produce proteins that regulate a variety of processes in living organisms, not just the kind of coat a dog has. That makes them relevant to diseases of dogs and humans.

'We think this approach will help pinpoint multiple genes involved in complex human conditions, such as cancer, heart disease, diabetes and obesity,' says Dr Ostrander.