VETERINARY TODAY

Popular Article
ISSN:2583-8288

Present and Future aspect of Y-chromosome

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The Y-chromosome is one of a pair of chromosomes that determine the genetic sex of individuals in mammals. When the chromosomes were discovered then both the X & Y chromosomes had same size and contain all the same genes. But during evolution the size of Y chromosome becomes decreased. Y chromosomes have a fundamental flaw. Y chromosomes are present as a single copy, inherited from fathers to his sons, unlike all other chromosomes, which contain two copies. Because there cannot be genetic recombination between genes on the Y chromosome, there can be no reassortment, which prevents harmful mutations from being separately chosen against. The master-switch gene for sex determination, also known as the sex-determining region Y, is located on the Y chromosome (SRY gene). If a fertilized egg cell, called a zygote, has the SRY gene, the zygote develops into an embryo that has male sex traits. If the zygote lacks the SRY gene, the zygote develops into an embryo that has female sex traits. The Y-chromosome lost most of its ability to recombine after the evolution of the SRY gene, and a large inversion occurred on the Y-chromosome. There is a tendency for non-paired chromosomes or non-recombining chromosomes to decay to the point where they no longer function, only genes essential for male fertility have retained their function on the Y-chromosome, while most of the other genes are decayed versions of genes located on the X-chromosome. It contains very few other genes and is the only chromosome not necessary for life. Women, after all, manage just fine without one.

What is happening with the Y chromosome?

Some studies shown that, it has been degenerating rapidly and just 4.6 million years are left before it disappears completely. Unlike others, the Y chromosome has no pair, so it might fall weak before the evolutionary forces.

You might have pondered why a boy with a bald father always inherits this quality. It is impossible to quiet or find a substitute for the defective Y chromosomal genes. Compared to women, who have two X chromosomes, defective genes on one chromosome cannot be silenced by genes on the opposite chromosome. As a result, genetic recombination, or the "shuffling" of genes that takes place every generation and helps in the elimination of harmful gene mutations, cannot occur on the Y chromosome. According to certain research, Y chromosomes have evolved through time into self-preserving "Palindroms," which protect it from further degeneration. The chromosome has considerably shrunk over the span of 200 million years of evolution, according to scientific observation.

When we hear that the Y chromosome is disappearing, our thoughts will start to wander and we'll start to worry about what will happen to males. Are we making space for a new species or will they eventually disappear? Researchers at Hokkaido University in Japan have made sure that men won't disappear any relatively soon. In some ways, the way the Y chromosome disappeared from a particular male species of rat has provided us with a roadmap for how the same thing may occur with human males.

What this means for the future of men?

Future scenarios have been discussed in the context of the Y chromosome's approaching extinction, at least in evolutionary terms. A process known as parthenogenesis allows some lizard and snake species, which are only found in females, to produce eggs from their own DNA. However, neither humans nor other mammals can experience this as we possess at least 30 essential genes that are "imprinted" and only function when passed on from the father by sperm.

Because males and sperm are required for reproduction, the loss of the Y chromosome may indicate the end of the human race. The latest discovery gives support to a different hypothesis, namely that humans may develop a new sex-specific gene. However, there are dangers involved with the introduction of a new sex gene. The split of new species as a result of a "struggle" of the sex genes has occurred in mole voles and spiny rats. Thus, if someone travelled to Earth in 11 million years, they may not find any people there or find a variety of different human species, each with its own method of determining sex. This gene heteromorphism is caused by the majority of the Y chromosome's genes no longer functioning. Due to the Y's unidirectional transmission from father to son and absence of sexual recombination, it has undergone degeneration. Natural selection is less effective in non-recombining genomes because selection at one site interacts with the actions of selection at related sites. On a non-recombining Y chromosome, two types of natural selection can prevent the elimination of harmful mutations. According to models that only include negative selection, the actual number of Y chromosomes decreases as harmful mutations are continuously eliminated by purifying selection. Thus increase the effects of genetic drift, decreasing the overall effectiveness of purifying selection. Due to background selection and Muller's ratchet models, harmful mutations can only accumulate on the Y as a result of other deleterious mutations. An alternate hypothesis is that the Y chromosome's degradation is significantly influenced by positive selection. According to this theory, associated harmful mutations are carried along by repeated fixations of highly desirable mutations (selective sweeps).

Type of gene located on the Y chromosome that is working like the growth of testes, the production of sperm and determining the sex of the child. Y chromosomes and other older Y chromosomes hardly show any signs of the degenerative processes that lead to them. Analyzing patterns of diversity on young Y chromosomes that are still experiencing degeneration offers the best chance of differentiating between positive and negative selection as reasons of degeneration. The selective sweep model predicts a marked excess of low-frequency mutations relative to neutral expectations, whereas negative selection models produce a less severe distortion in the frequency spectrum of mutations, even though both positive and negative selection models might account for reduced variability on an evolving Y chromosome.

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