Scientific and Social Research, 2021, Volume 3, Issue 3
http://journals.innosciencepress.com/index.php/ssr
ISSN Online: 2661-4332

Genome Sequence between Human and Chimpanzee

Chenyu Fu*

The Webb School, Tennessee, the United States

***Corresponding author:** Chenyu Fu, wfu22@webbschool.com

Abstract: Human evolution is a very complicated and lengthy process. Around six million years ago, humans were still apelike creatures. However, in modern times, humans have already evolved into a species called homo sapiens. The first species which shows human traits are bipedalism; they can walk on two legs. There are about 12-15 different early human species, but not all of them lived till today. It is well known that chimpanzees and humans shared a common ancestor six to seven million years ago. Chimpanzees are genetically closest to humans; they share about 96% of Human DNA sequences [1]. However, during evolution, chimpanzees and humans diverged into two different paths and finally demonstrated other behavior and into two completely different species. Modern-day humans can develop society and show high intelligence. However, for chimpanzees, they are still at a phase where they only demonstrate animal behavior. Chimpanzees and humans developed completely different behavior not only due to the different environments they lived in, but also due to the gene differences.

Keywords: Genome sequence; Human DNA; Chimpanzee DNA

Publication date: September 2021; ***Online publication:*** September 30, 2021

1. Introduction

Scientists conducted an experiment called the Chimpanzee Genome Sequencing Experiment. It is an experiment where they sequence both humans and chimpanzees' genome to study the similarities and differences between these two species. It answers the question of which 4% gene difference caused the difference between chimpanzees and humans [2]. Scientists found out that many diseases are common to humans, but rarely happened to the chimpanzees; therefore, they sequence the genome to see which part of the gene causes that. For example, the HIV progression to AIDS, Myocardial infarction, and Atherosclerotic strokes are prevalent in humans but are very rare in chimpanzees [3]. Also, scientists believe that some phenotype features are only human-specific, such as relative brain size, gestural communication, olfactory sense, etc. The experiment has shown that there are 1% of single nucleotide divergence differences between two genomes, with about 90Mb (3%) of insertion and deletion of genes between them, and some rearrangement of chromosomes, a total of 4% difference between these two genomes [3].The scientists used several methods to determine these differences, such as using outgroups to define human-specific changes; examine chromosomes change; examine parts where insertion and deletion occur; parts where gene duplicated and retroposed; gene conversion. Although there are differences between the two genomes, that doesn't means which lineage experienced the change; therefore, the scientists need to use outgroups to study their ancestral state. They need to create a signal of polarity to determine the large divergence between chimpanzees and humans, to know what mutational events happened to their genes [3]. Scientists also

examine the sites of human-specific chromosome changes. They found out that there are some particular and very small inversions and rearrangements between human and chimpanzee genomes during the experiment. They used other great apes' species to determine whether these chromosomal changes are only human-specific since these little changes can cause a significant difference between humans and chimpanzees.

Moreover, scientists examine the part where insertion and deletion occur in the genes. Insertion and deletion can occur within a single nucleotide to tens of kilobases. They have a significant impact on the structure and function of the genes, and if the number of insertions and deletions are lower than the single nucleotide divergence, it means these insertions and deletions have been adaptive. Some known changes caused by these insertions and deletions include loss of the RLN genes, which will cause the difference between reproductive organs, deletion of the ASPM genes will make humans have increased brain size or other features of the human brain, which may be why humans and chimpanzees demonstrate different behavior [3]. Also, SPANX genes' insertion may be why humans are exposed to more types of cancers than chimpanzees. Therefore, the insertion and deletion of genes can greatly impact the difference between humans and chimpanzees.

Duplicated and retroposed genes are related to gene conversions. Gene duplication is a process where the mRNA sequence creates new genes with new biological functions. They can become pseudogenes, neo functional genes, or sub functional genes. These are important things which contributed to the difference between chimpanzees and humans because gene duplication indicated that there would be some new function which is only specific to one species. There are about 33% of gene duplication that are human-specific; it suggests that humans have experienced more gene duplications than chimpanzees. Here comes the question of gene conversions; gene conversion sometimes introduces mutations from a pseudogene into a functional gene or reversion can happen. This will cause some structures of the gene to no function and change for specific species. For example, the 5 ends of human Siglec 11 were converted by a pseudogene after the common ancestor of the chimpanzee, which causes the structure of the human brain microglia to change. And this converted gene is the first human-specific protein.

Besides the difference in genes that cause humans and chimpanzees to develop into two completely different species, there is also the factor of the environment they lived in. As in ancient times, humans and chimpanzees share a common ancestor, but when they diverged in the evolution process, humans moved to Africa, and chimpanzees still lived in the forest. Since it is a plain area, some evidence indicated that humans might need to stand up to get the food on the trees, which help them develop the ability of walking and get bipedalism more going [4]. Research on the chimpanzees from tropical and savanna indicates that ancient humans evolved upright posture may be caused by the high temperature in the savanna.

Although there are some distinct differences between humans and chimpanzees, chimpanzees still show that they can develop like humans, not entirely, but partially. There is an experiment like project Gua, which is an experiment where a baby chimpanzee lives together with a human baby; as time gradually passed, the baby chimpanzee demonstrates the similar behavior to human baby, and the human baby did the same things, which indicates that chimpanzee can imitate human [5].

Based on all the evidence the chimpanzee genome sequencing experiment provides, although a 4% difference doesn't sound like a big difference, but the things like intel genes, conversion of genes, duplications of genes can greatly cause behavioral, physiology, and gene differences between humans and chimpanzees. Therefore, there is still much evidence we haven't got through yet. However, the difference between humans and chimpanzees is caused both by gene changes and environmental issues.

Disclosure statement

The author declares no conflict of interest.

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