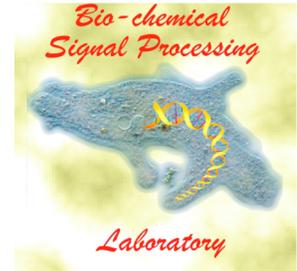




The GULO Gene

Where did our ability to synthesize Vitamin C get lost?

Andrea Ochadlick and Gail Rosen



GULO & GULOP

GULO

- 98% of organisms can synthesize their own Vitamin C
- The GULO gene allows Vitamin C synthesis
- Millions of years ago a mutation caused humans, and other mammals, to lose the ability to synthesize this gene
- Now humans must intake a sufficient amount of Vitamin C to survive
- GULO Pseudo gene
- GULOP
- A non-functional gene which doesn't allow Vitamin C synthesis
- Almost identical to functional gene
- Contains a mutation that change the gene and its abilities

Animals researched that...

- | | |
|------------------------------------|---------------------------------------|
| Can synthesize their own Vitamin C | Cannot synthesize their own Vitamin C |
| •Dog | •Pig |
| •Rat | •Human |
| | •Guinea Pig |

Genbank

Genbank is...

- Publicly available nucleotide sequence and protein translation
- Continues to grow; doubles every ten months
- Receives sequences produced in laboratories throughout the world



This is a common snap shot of what can be seen on Genbank. It is one of the many things that can be accomplished on this database. This shows sequence of the GULO gene in pigs.

BLAST

Basic Local Alignment Search Tool

- Compares biological sequence information
 - Amino acid sequences of different proteins
 - Nucleotides of DNA sequences
- Allows comparison of a sequence with a library of databases that resembles the main sequence
- BLAST with GULO
- Used to compare two organisms' GULO gene sequence to each other
- Found similarities in sequence
- Shown percent identity and number of base pairs (bp- two nucleotides on opposite complementary DNA or RNA strands that are connected by hydrogen bonds)

Base Pairs

Organism	Base pairs
Rat (Gulo)	23330
Dog (Gulo)	31789
Guinea pig (GuloP)	4612
Pig (GuloP)	158
Human (GuloP)	107

•Shown here is a base pairs chart. Organisms without the GULO gene essentially have the least amount of base pairs

Organisms compared

Organisms Compared to Human

Organism	Percent identity
Pig (GuloP)	91%
Guinea Pig (GuloP)	91%
Rat (Gulo)	81%
Dog (Gulo)	20%

- To show the similarities between organisms and the GULO gene, the percent identity is shown
- Percent Identity- percent that a gene relates to another that it is being compared to
- It is seen here that the organisms that can not simulate their own Vitamin C, relate the most to the human

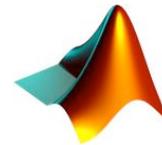
MATLAB

Background

- Numerical computing environment and programming language
- Created by the MathWorks
- Plots functions and data
- Implementation of algorithms

For this project

- A basic understanding of MATLAB was needed
- Used for helping with DNA
 - Comparing
 - Analyzing
 - Density charts
 - Sequences
 - Random sequences of DNA



Nucleotide Density

Genbank

- DNA sequences found in Genbank
- Sequences of GULO gene save as FASTA file

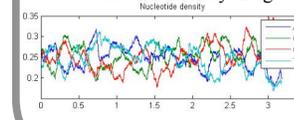
MATLAB

- Sequences opened in MATLAB
- Ntdensity command used
- Nucleotide density chart shown

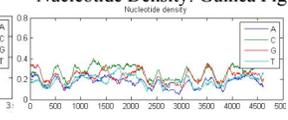
Nucleotide Density Charts

- Shows percent of each base throughout the gene
- Allows comparison of bases in different gene sequences

Nucleotide Density: Dog



Nucleotide Density: Guinea Pig



Results

- When comparing different organisms with or without the GULO gene, the GULOP sequence is shorter than the GULO gene.
- Using Genbank and BLAST, the GULOP sequence has higher percent identities to humans.
- With the help of MATLAB, the nucleotide densities are more consistent in GULOP rather than GULO genes.

Conclusion

- In this study, we investigated why a pig, guinea pig and human cannot synthesize their own Vitamin C
- A dog and rat have the ability to synthesize their own Vitamin C
- Organisms with the GULO gene have less base pairs in common with organisms without the GULO gene
- When comparing to humans, organisms without the GULO gene have a higher percent identity that those with the gene