Biological Robustness and Fragility

Biological robustness refers to the function of the biological system remaining unchanged when particular disturbance or perturbation was involved. It is known as the basic feature of biological evolution. Robustness is most likely to be genes that are strongly stable due to surviving for years of natural selection.

One of the examples for biological robustness is the life cycle of λ-phage, which is the bacteriophage that infect bacteria. When λ-phage infects the bacterial cell, they may undergo two types of life cycle, the lysogenic cycle, and the lytic cycle. If the λ-phage undergoes lysogenic cycle, λ-phage genome will integrate into the bacteria, host cell chromosomes and replicates in the host cell, while if the phage undergoes the lytic cycle, it will destroy the host cell after forming many copies of the phage. The selection of which cycle the phage enters is the robustness against point mutation. The promoter region of λ-phage consists of two promoters, lytic promoter P_R and promoter transcribes for the lysogen $P_{RM.}$ As the positive feedback and negative feedback given, causes point mutation at the promoter occurs, the binding affinity of the promoter changes, which makes it to be non-specific. This behavior shows the robustness against the point mutation at the promoter.

Biological fragility is when the biological system experience unexpected mutations, it might become fragility. It is usually due to the exposure to unusual stimulus, which robustness fail to maintain the normal function of the organs or systems, causing crush up of system, which is fragility.

The example of biological fragility is diabetes mellitus. When the body is receiving high energy content food, in this case, carbohydrate rich food, for a consistently long period of time, but the person is not making full use of the carbohydrates, leading to the chronic glucose overdosage. The metabolic system might try to sustain however when they start facing evolution, mutation causes changes in the metabolic system, leads to the occurrence of diabetes mellitus, which is fragility.

Biological robustness is essential for survival as it remains stability of the system in the molecular level even when evolution occurs. It helps maintain the main function for the body for survival even if being infected. However, there some diseases might take advantage of the system and instead of stabilizing the normal function of the body, they maintain the disease state and go on to further improvement.

Consequences of fragility are the change in metabolism, and even the spoilage of homeostasis. To avoid fragility, I think the best way is to prevent the exposure to long term stimulus. Long period of unusual event to the body leads to mutation, messing up the body normal function.

In conclusion, biological robustness and fragility might be an advantage and disadvantage to the biological system. If the robustness is use in a good way, which is for example maintaining the normal function of the body to keep the body working, even when mutation occurs, it is definitely an advantage for human. It may become a treatment against fragility caused by mutation. But if robustness is being use by infections, causing the disease to be long lasting, it will become a disadvantage. Same for fragility, it is usually a bad thing for human beings as it leads to bad results and break the homeostasis in our body. However, when it is being use by infections, breaking the bacteria or virus normal life cycle, it might be an advantage for biological system.

Reference

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