Hypothesis of the conjunct expression gene: can random mutation explain the phenotypic variability?

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Abstract: The epigenome regulates the gene expression of all differentiated cells and indicates which specific genes must be transcribed. It is argued that the expression factors that act in specific genes of the somatic cells involved in a behavior also act in the partial transcription of the same genes in the most undifferentiated cells of the germ line. It is proposed how a probabilistic view of the random mutation can explain the evolution of the phenotypes and integrate all the evidence pointing to a conjunct evolution with the environment.

Keywords: evolution, gametogenesis, transcription, mutation, epigenome, isochores.

Introduction

In the last ten years a discussion has been developed on whether evolutionary theory needs to be rethought, and the cause has been evidence suggesting that phenotypic variability cannot be due solely to random mutation (*1-3*). For a phenotype can to appear it is necessary for the cell to express only a specific portion of the DNA contained in the nucleus. The epigenome is responsible for regulating the expression of specific genes that the cell needs for differentiate in the presence of the factors that regulate transcription (*4*, *5*). Here is proposed that the expression of specific genes in a given phenotype due to the high demand

of gene resources for the behavior of an organism during the development, increases the probability of a random mutation for these genes during gametogenesis, and that the evolution of phenotypes associated with the environment in where it develops is the result of the probability of a random mutation linked to the partial transcription of high demand genes occur during replication considering for all the processes involved the probability that this mutation is not repaired, adding to this the probability that the mutation will have consequences on the phenotype, the likelihood that the resulting phenotype will provide an advantage for survival or reproduction, plus the likelihood of the natural selection will act in favor of the phenotype (Fig. 1).

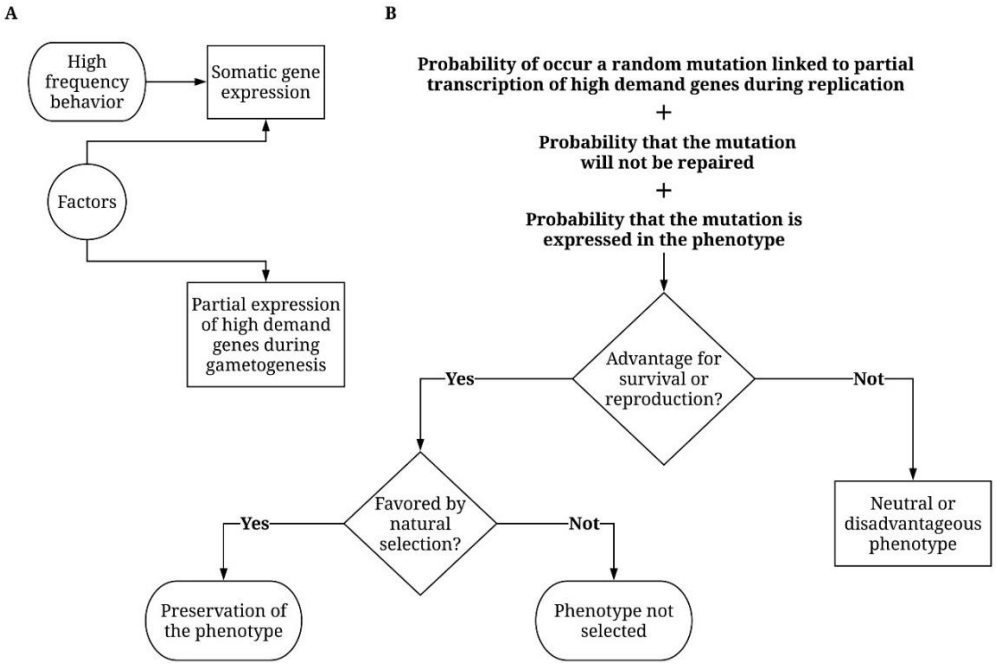

Figure 1. A) Hypothesis of the conjunct expression gene. The factors that regulate gene expression in the somatic cells also act in the most undifferentiated cells of the germ line during gametogenesis. B) Probabilistic view of the random mutation that increases the mutation rate for the high demand genes. Natural selection is the mechanism responsible for the conservation of the phenotype.

Discussion

There is evidence that exposure to specific stimulus can regulate the gene expression of the somatic cells involved (*6*). This is notorious in birds of the Passeriformes order where of singing behavior is sexually dimorphic, implying that during embryogenesis, oogenesis and spermatogenesis, different genes involved in behavior are expressed (*7*). A similar epigenetic mechanism biased by sex has recently been documented in mammals (*8*). It has been proposed that the type of mechanism that regulates a behavior can influence the probability that phenotypic plasticity evolve (*9*). Here it is suggested that the factors that regulate the gene expression of somatic cells involved in a high frequency behavior can induce the partial transcription of the high demand genes in the most undifferentiated cells of the germ line.

In birds of the Passeriformes order, platelet phosphofructokinase is a tissue enzyme that should not be expressed during gametogenesis, and yet it does partial so in one or several steps of this process. It has been suggested that the phosphofructokinase gene in birds of this order has raised its GC content intragenic not only by mutation pressure by replication but also by mutation pressure associated to transcription (*10*). The autonomous transcription of genes that should not be expressed during gametogenesis can be explained with the hypothesis here present (Fig. 1).

Isochores are regions in the genome with rich in GC contend that can also be intragenic (intrachores) (*10*). There is evidence that associates the content of GC with the levels of expression (*11*). If the transcription rate is directly proportional to the genic demand, the exons located in isochores rich in GC they should be under strong mutation pressure, as in the case of the fosfofructoquinasa enzyme tissue that could have increased their intragenic GC contend, probably due to the changes in the metabolic rate in birds of Passeriformes order

during the ultimate 91.4-47.1 million years (*10*). Also, empirical evidence in studies on pre-implantation in human and mouse indicated that of levels of expression increased for those genes that were found in regions of DNA with high GC contend, from early to late stages, while than those that showed low contend of GC they decreased their levels of expression (*11*). As well, it is had reported evidence that in the hexaploid genome of wheat, the levels of expression and the presence of isochores, indicate that these last act as an epigenetic determinant regulator of the transcription (*12*). Is necessary realized more studies that contribute with evidence empirical on the evolutive function of the isochores.

Conclusion

Factors that regulate gene expression in the somatic cells can increase the mutation rate during replication by mutation pressure associate to transcription depending on the frequency of stimulus, but these cannot be inherited, and this has been the barrier that prevents accepting the fact that the environment does can influence the evolution of the phenotypes (*1-3*, *9*). Although not directly, gene expression of the somatic cells due a behavior, for example the construction of the niche (*13*, *14*), can increase the probability that of a random mutation on spermatogonia and oogonia (that are undifferentiated cells and that give rise to the gametes that does transmitted the genetic information to the next generation) due to presence of the factors that regulate the transcription of the genes involved in the behavior, raising of this way the mutation rate. Studies that will correlation the genic demand of the somatic cells with the transcription rate of the cells involved in a behavior and of the undifferentiated cells of the germ line, that will show a strong correlation, would evidence of the conjunct expression of the genetic resources. It should be clarified that the function is independent of the structure, and it cannot be affirmed that a structure evolved to perform a specific function

because the mutation was a random event. Accordingly, the evolutionary theory does not really need to be rethought, since a probabilistic view of the random mutation can integrate all the evidence pointing to an evolution of the conjunct phenotype with the environment.

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