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Hypotheses on the evolutional process and meaningful function of organisms: mitochondria, plants, mammals

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Mitochondrial coexistence in eukaryotic cells is an important theme in biology, and its process and relationship with the subsequent evolutionary history of life continue to be studied. The roles and functions of plants remain unknown and continue to be studied. Mammals have complex organs and well-developed immune systems, and reproduce by a specialized method called embryogenesis. In this study, we propose several hypotheses to explain the evolutionary process and current state of these organisms. In Chapter 1, we propose several hypotheses regarding the advantages gained by mitochondria through their symbiosis within eukaryotic cells. Then, we discuss the relationship between the sharing of functions between mitochondria and multicellular organisms in the symbiosis of mitochondria within eukaryotic cells. In Chapter 2, we propose several hypotheses regarding the roles of plants in the environment, ecosystems, and strategies for species expansion are summarized. In Chapter 3, we propose several hypotheses regarding the ecology of mammals and the advantages of reproduction by embryogenesis are explained.

key words: mitochondria , plants , mammals

1. Advantages Gained by Mitochondria through Intracellular Symbiosis

1.1 Background and Objectives

Mitochondria are the organelles responsible for energy production in eukaryotic cells. Mitochondria were originally aerobic bacteria and are thought to have been incorporated into eukaryotes as cell organelles to use the ATP produced by mitochondrial respiration. The mitochondria need an endoskeleton to be incorporated into the cell by phagocytosis; in 2017, a gene cluster for an endoskeleton was discovered in the prokaryotic Asgard archaea [Zaremba-Niedzwiedzka et al. 2017], and the theory of mitochondrial intracellular symbiosis is currently gaining traction. Research has shown that a symbiotic relationship exists between methane-producing bacteria and sulfate-reducing bacteria [1] . A symbiotic relationship between sulfate-reducing bacteria and α-proteobacteria has also been found to exist [2] . Sulfate-reducing bacteria have been found to corrode iron in anaerobic conditions by extracting electrons from iron and leaching Fe^{2+} [3]. In addition, methanogenic bacteria hydrolyze polysaccharides and produce methane from glucose [4] . Regarding the intracellular symbiosis of mitochondria into eukaryotes, in 2019, a hypothesis - the Entangle-Engulf-Endogenize (E3) model was proposed. At that hypothesis, it is insisted that during the evolution of eukaryotes, a symbiotic relationship exists between sulfate-reducing bacteria, Asgard archaea, and alpha proteobacteria, and through this symbiotic relationship, eukaryotes arose. In this paper, we propose the hypothesis that such a symbiotic relationship may have arisen during the evolution of eukaryotes due to the supply of other substances.

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1 https://www.jstage.jst.go.jp/article/sasj1971/27/4/27_4_231/_pdf/-char/ja

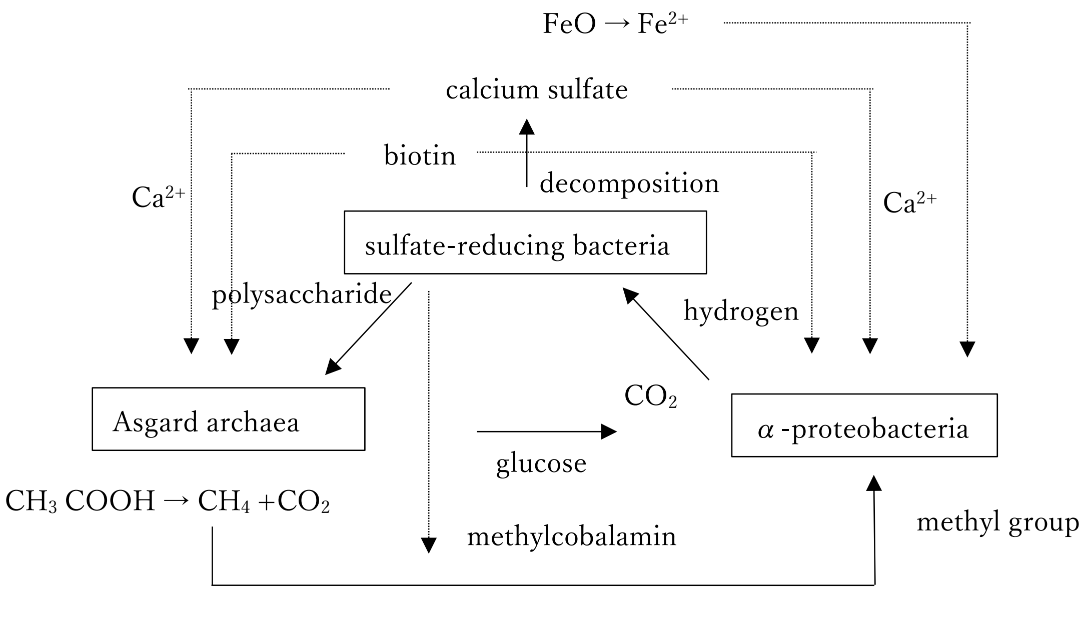
2 https://kaken.nii.ac.jp/en/grant/KAKENHI-PUBLICLY-20H05584/

3 https://www.nims.go.jp/news/press/2018/02/hdfqf1000009hdu9-att/p201802170.pdf

4 http://www.shinshu-u.ac.jp/group/env-sci/Vol41/paper2019/41-9_matsumoto.pdf

1.1.1 Hypothesis

As shown below, were calcium ions obtained from the decomposition of calcium sulfate by sulfate-reducing bacteria supplied to the Asgard archaea and α-proteobacteria? Were iron (II) ions leached from iron compounds by sulfate-reducing bacteria supplied to α-proteobacteria? Was the biotin produced by the sulfate-reducing bacteria supplied to the archaea and α-proteobacteria? The sulfate-reducing bacteria supplied the polysaccharides to the Asgard archaea, which hydrolyzed them into glucose and supplied them to the α-proteobacteria? The Asgard archaea decomposes the acetic acid produced by the oxidation of glucose into methane and carbon dioxide by anaerobic fermentation. The methane produced was converted to methyl groups by the methyl coenzyme M-reductase of Asgard archaea, which required methylcobalamin (derived from vitamin B12 produced by sulfate-reducing bacteria), and supplied to α-proteobacteria?



Methyl coenzyme M reductase

1.2 Background and Objectives

Mitochondria are thought to originate from aerobic bacteria, similar to α-proteobacteria [Imachi, 2020]. However, it has not been clarified what advantages mitochondria have derived from such intracellular symbiosis. Therefore, we propose a new hypothesis regarding the advantage that mitochondria gain through symbiosis in eukaryotic cells.

1.2.1 Advantage 1

Mitochondria require a large amount of antioxidants to scavenge ROS produced by respiration, and mitochondria have been parasitized in the cell because of the stable supply of antioxidants such as vitamin C, vitamin E, and lipoic acid in the cytoplasm, which they can accept and use because of the stable supply of antioxidants such as vitamin C, vitamin E, and lipoic acid in the cytoplasm and the ability to accept and use them to eliminate reactive oxygen species that have a strong effect on tissue damage caused by intracellular respiration.

1.2.2 Advantage 2

Mitochondria are vulnerable to changes in PH, and mitochondrial disease is associated with acidosis and alkalosis in the body. Because PH is maintained constant in the cell by the individual's PH buffering[5], are mitochondria more readily able to metabolize and divide?

1.2.3 Advantage 3

[5] https://www.natureasia.com/ja-jp/nature/highlights/41037

In eukaryotic cells, is there a stable supply of methyl groups from individual metabolism, so that mitochondria can enjoy the methyl groups necessary for metabolism and division?

1.2.4 Advantages4

Are mitochondria able to avoid or suppress the entry of mitoviruses that infect themselves because there is little risk of viral entry in eukaryotic cells due to the individual's immune mechanism?

1.2.5 Advantage 5

Symbiosis within eukaryotes allows them to metabolize and multiply in a stable environment, and the movement of eukaryotes allows them to move into new frontiers.

1.2.6 Advantage 6

As cell organelles in multicellular organisms, does the ability to metabolize and communicate with each other within a population of individuals give mitochondria any advantage in metabolism or in dividing and proliferating?

1.2.7 Advantage 7

Since the Asgard archaea had a high capacity to break down substances, could mitochondria enjoy the substances after they were broken down and metabolize them, saving the energy needed to break down the substances?

1.3.1 Hypothesis 1

Have eukaryotes coevolved, with reproduction selecting for individuals with more energy-efficient mitochondria and mitochondria selecting for cells that provide a better environment?

1.3.2 Hypothesis 2

Does symbiosis of anaerobic and aerobic bacteria enhance individual homeostasis and stress tolerance?

1.3.3 Hypothesis 3

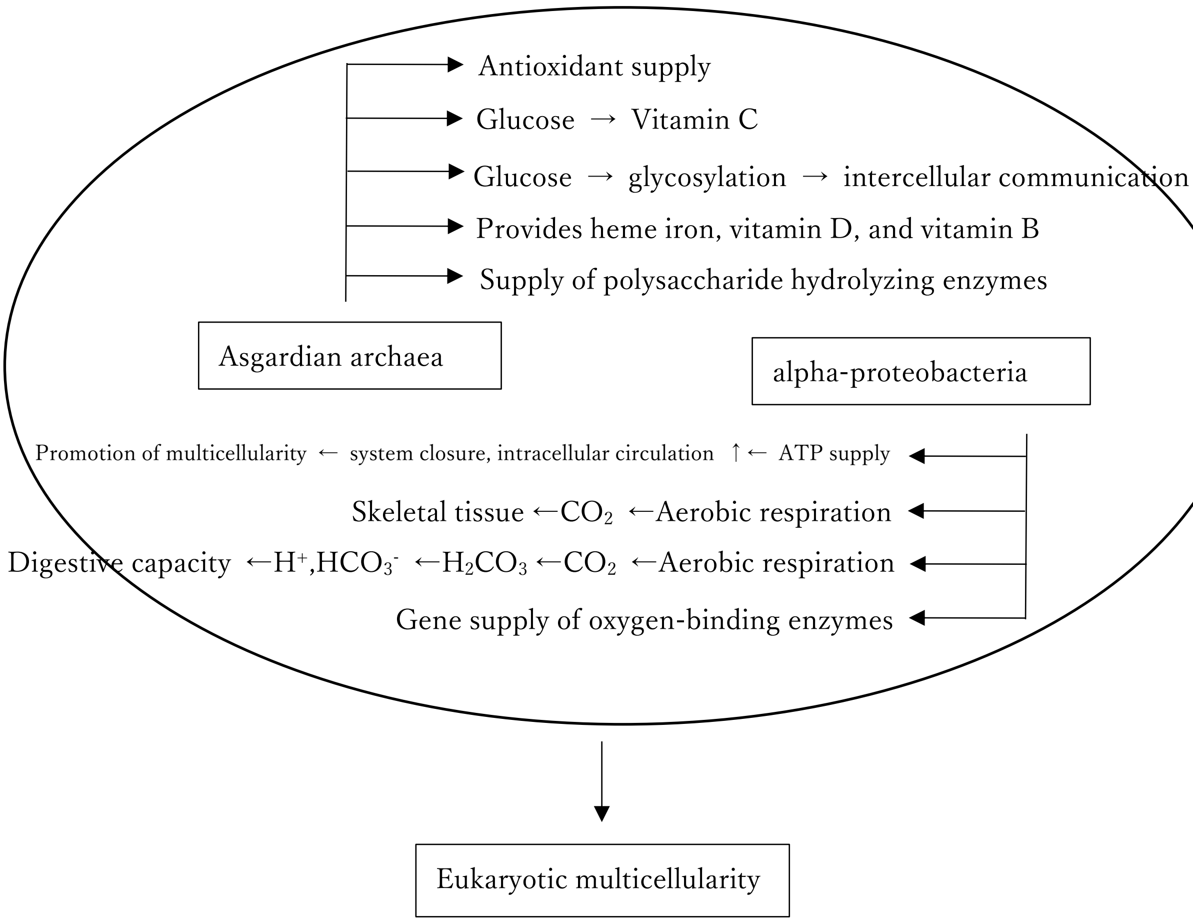
Is the symbiosis of mitochondria with eukaryotes due to aerobic respiration performed by mitochondria, which fixes carbon and facilitates the formation of skeletal tissue?

1.3.4 Hypothesis 4

Did mitochondria facilitate the acquisition of eukaryotic oxygen transport systems by conferring genes for enzymes with oxygen-binding capacity on eukaryotes?

1.3.5 Hypothesis 5

Due to the common benefits of oxygen and glucose transport, ATP supply, and monopoly, eukaryotes could operate in groups, and the supply of surplus energy allowed both cells that were unable to operate autonomously due to mutations to survive. Does this promote functional differentiation of cells?



2. Evolution of Plants

2.1.1 Do plants facilitate the movement of water and materials within vascular bundles by the stem flexure caused by wind swaying?

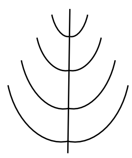
2.1.2 Do plants store water in their tissues through photosynthesis of glucose?

2.1.3 Do plants suppress the increase in leaf tissue temperature by endothermicity associated with photosynthetic reactions?

2.1.4 Do plant petals mimic the sun to attract phototactic insects?

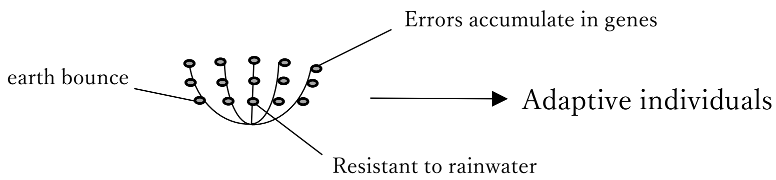
2.1.5 Does the sugar content in plant fruits inhibit the invasion and growth of bacteria and viruses in tissues?

2.1.6 Do plants gather information about the magnitude of gravity by radially branching branches and adjust their balance so that the stem is perpendicular to the ground?



2.1.7 Do plants disperse kinetic energy by accepting and reversing wind-driven swaying branches by contacting branches in the vicinity?

2.1.8 Plants have radial stems and branches along which they arrive. By trying which of these seeds remain and germinate, do we select individuals that are adaptive to the environment?



2.1.9 Do plants use the space occupied by their roots, stems, and leaves as their territory to release metabolites into the environment to attract desirable insects and other animals and repel undesirable ones?

2.1.10 Are plants responsible for maintaining the division of labor in the supply of materials to the environment and the order of insect networks by attracting specific plant species to particular insect species?

2.1.11 Does defoliation by deciduous trees remove nitrogen from the body?

2.1.12 Is defoliation a system that provides nutrients derived from dead leaves and expands the environment that is conducive to seed growth?

2.1.13 Do plants change generations in order to move to an environment that is more suitable for their growth and in which they can contribute to the ecosystem through the substances they supply?

2.1.14 In the history of life on Earth, do plants, which came into existence before animals and have been responsible for fostering soil tissue, releasing oxygen into the atmosphere, supplying food and providing shelter, generally have the ability to enhance and maintain amenities for animal life and activity?

2.1.15 Have plants and insects developed mechanisms to suppress viral infections and choose to select traits through mutual coevolution? Do plants and insects compensate for the reduced rate of evolution by producing large numbers of gametes and eggs?

2.1.16 Does dietary fiber in plant roots regulate the excess or deficit of minerals absorbed from soil?

2.1.17 Does fruiting and oviposition by a parent to leave offspring have an aspect of discharging toxins in the organism in addition to leaving offspring? Do the pulp of the seed and embryo of the egg both shed and accumulate toxins derived from the environment in which the parent lives, and do the offspring acquire tolerance to new toxins in the environment as the seed and egg undergo selection by these toxins?

(Please note that this is an untested hypothetical paper and additional experiments are needed to establish evidence.)

3. Mammalian Strengths

3.1 Background and Objectives

One of the strengths of mammals is that they nurture their young by lactation and thus do not leave their young to acquire food. In this study, we propose a new hypothesis regarding the advantage of mammals as a biological group.

3.1.1 Hypothesis 1

Immune tolerance resulting from suckling suppressed allergies and broadened the range of eating habits.

3.1.2 Hypothesis 2

Feeding by bottle-feeding has enabled infants to consume nutritious food from infancy.

3.1.3 Hypothesis 3

The mother is supplied with stem cells derived from the fetus.

3.1.4 Hypothesis 4

The supply of substances through the placenta establishes a chemical equilibrium between the mother and the fetus, making it difficult for the fetus to lack trace elements necessary for development.

3.1.5 Hypothesis 5

Transmission about epigenetics is transmitted from mother to offspring, and the development of the offspring becomes adaptive.

3.1.6 Hypothesis 6

Because of the rapid progression of development and growth, the physically vulnerable fetus can now be isolated in utero and development can take place protectively in a safe environment.

3.1.7 Hypothesis 7

The mother's perceived and immediate provision of the nutritional needs of the fetus for growth allowed development to proceed properly (change in maternal preference).

3.1.8 Hypothesis 8

By using the mother's ROS scavenging system, the fetus can now be protected from ROS.

3.1.9 Hypothesis 9

Evacuation of the entire mother from an unsafe environment has been shown to protect the life of the fetus.

3.1.10 Hypothesis 10

The development of the fetus in the uterus, an organ within the body, allows the fetus to be protected from ultraviolet radiation.

3.1.11 Hypothesis 11

By transferring and receiving substances through the placenta, the mother substitutes digestion and excretion for the fetus, allowing the fetus to concentrate on cell development and differentiation.

3.1.12 Hypothesis 12

Communication between the maternal and fetal brain via the placenta has been shown to promote brain development.

3.1.13 Hypothesis 13

The mother's experience in determining what food to consume and its nutritional supply to the fetus allows them to venture into complex environments that require a high level of intelligence for food gathering and capture.

3.1.14 Hypothesis 14

During the embryonic period, the development proceeds in amniotic fluid, which is sterile and able to protect the fetus from pathogenic microorganisms.

3.1.15 Hypothesis 15

The heat-producing system and PH buffering capacity of the mother allowed for generational change even in harsh environments.

3.1.16 Hypothesis 16

The child can now be identified and nurtured.

3.1.17 Hypothesis 17

Even when there is a lack of food in the environment, maternal fat can be used to supply nutrition to the fetus and to feed the infant.

3.1.18 Hypothesis 18

Nurturing in a protective environment during infancy suppresses the fight-or-flight response and enables the animal to acquire the ability to cooperate and cooperate as an adult.

3.1.19 Hypothesis 19

When the number of offspring in a population decreases, resources are concentrated in those individuals and genes remain. On the other hand, when the number of offspring in a population is large, selection is promoted by competition within the population and dominant genes remain. This mechanism promotes both the survival of the species and the selection of dominant individuals.

(Please note that this is an untested hypothetical paper and additional experiments are needed to establish evidence.)

[Citation.]

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