

Energy Production, the Main Role of Melanin in the Mesencephalon

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Abstract

The explanation about the function of melanin in the substantia nigra at mesencephalon has been elicited diverse theories, being considered its presence in midbrain only as a by-product of dopamine metabolism. Our discovery of the intrinsic property of melanin to split and re-form the water molecule breaks the ground: the main function of melanin in mesencephalon (and anywhere) is energy production. Thereby melanin is the fundamental source of energy indispensable to dopamine metabolism.

Keywords: Melanin, energy, photosynthesis, hydrogen, Parkinson.

1 Introduction

The black/brown pigmented granules of melanin in the human central nervous system have been observed since 1930s. The most pigmented regions are two mesencephalic areas: Sömmering's substantia nigra and the locus ceruleus [1]. Histological studies on human substantia nigra and locus ceruleus showed that neuro-melanin granules were located in the neuronal perikaryon and were surrounded by a double membrane [2] similar those of the cell membrane. In mammals melanin granules inside the cell are called melanosomes, and characteristically trend to form and envelop around the nucleus and are placed in the perinuclear space.

The mesencephalic dopaminergic system is involved in the control of multiple brain functions including visual sensations, movement control and emotions [3]. Melanins are found in highly oxidizing situations where significant concentrations situations where

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significant concentrations of oxygen radicals are generated. Such reactive oxygen species (ROS) are produced by UV-light in the skin and eye, by sound and ultrasound in the inner ear, and in the highly oxidizing conditions of catecholaminergic neurons in the brain [4]. There is accumulating evidence that the evolution of melanogenesis in human melanocytes is primarily antioxidant in character and is designed to protect these pigment cells from the cytotoxicity of ROS. Melanocytes in the human epidermis (in vivo) or in cell cultures have been shown to be much more sensitive to the cytotoxicity of ROS than keratinocytes.

50 % lesion of the substantia nigra pars compacta (SNpc) suffices to produce disruptions of several parameters in the sleep-wake pattern of rats [5]. Therefore dopaminergic neurons present in the SNpc possess a fundamental function in the regulation of sleep processes, particularly in promoting REM sleep.

Parkinson's disease (PD) is a neurodegenerative disorder characterized by the selective death of pigmented substantia nigra neurons [6], with a consequent impairment of the nigrostriatal pathway, resulting in a clinical syndrome characterized by tremor, rigidity, and severely impaired motility. This pathway drives control and initiates motor plans, from the dorsal striatum to the motor cortex and back to the cortex via the thalamus. The pigmented substantia nigra neurons are more vulnerable than the non-pigmented ones (Cotzias and Papavasidou, 1964); but at light of the finding of the intrinsic property of melanin to split and re-form the water molecule [7], seems as the energy requirements of the pigmented substantia nigra neurons are greater than non-pigmented ones, due to their shape, location and function.

Dopaminergic neurons resident in the substantia nigra pars compacta (SNpc) possess a central role in the regulation of sleep processes, particularly of REM sleep, therefore the SNpc can be considered as an integrative area of biological function, a formidable task that undoubtedly requires huge amounts of energy.

There are crucial structures in mid-brain, with fundamental and diverse functions, however there is a very first intracellular requirement in common: enough free chemical energy available; otherwise the cells cannot carry out their highly complex functions developed along four billion years of evolution. However, glucose cannot be the source of energy; in that case diabetic patients must be able to fly.

2 Photosynthesis in Plants and Humans

2.1 Differences and Similarities between Human and Plants Photosynthesis

Our finding of the intrinsic property of melanin to split and re-form the water molecule constitutes a disruptive knowledge. Our body is able to take energy from light, therefore has the astonishing capacity to use water as source of electrons, a previously unknown fact.

The biochemical reaction inside melanin found by our team since 1990s can be schematized as follows:



The water molecule is dissociated in diatomic hydrogen and oxygen, but more important, the molecule with a real value is hydrogen, because is the energy carrier by excellence in the entire universe, thereby our body (and plants) cannot be different in anyway; by other side, oxygen is toxic at any level, that is the reason why plants expelled it to atmosphere

after chlorophyll also dissociates irreversible the water molecule.

There are several differences and similarities between the dissociation of water that take place inside melanin and chlorophyll [8].

2.2 Brief Description of Midbrain

The mesencephalon or mid-brain is an anatomical structure present in mammals and practically in animal kingdom all, therefore is a character highly conserved in evolution. We could say that the importance of its function is out of discussion.

The mid-brain or mesencephalon is the short, constricted portion which connects the pons and cerebellum with the thalamencephalon and cerebral hemispheres. It is directed upward and forward, and consists of a ventrolateral portion, composed of a pair of cylindrical bodies, named the cerebral peduncles; a dorsal portion, consisting of four rounded eminences, named the corpora quadrigemina; and an intervening passage or tunnel, the cerebral aqueduct, which represents the original cavity of the mid-brain and connects the third with the fourth ventricle.

The **substantia nigra** (*intercalatum*) is a layer of gray substance containing numerous deeply pigmented, multipolar nerve cells. It is semilunar on transverse section, its concavity being directed toward the tegmentum; from its convexity, prolongations extend between the fibers of the base of the peduncle. Thicker medially than laterally, it reaches from the oculi-motor sulcus to the lateral sulcus, and extends from the upper surface of the pons to the sub-thalamic region; its medial part is traversed by the fibers of the oculi-motor nerve as these stream forward to reach the oculi-motor sulcus. The connections of the cells of the substantia nigra have not been definitely established. It receives collaterals from the medial lemniscuses and the pyramidal bundles.

The mid-brain is the portion of the brainstem that connects the hindbrain and the forebrain. Are the smallest region of the brainstem and the functions of are associated with vision, hearing, motor control, sleep/wake, arousal (alertness), and temperature regulation; also include: controlling responses to sight, eye movement, pupil dilation, body movement, and hearing.

Due to that mesencephalon has a significant cell number, and also has axons whose nucleus are in other areas as cerebral cortex or in medulla; besides important association pathways; and numerous highly complex functions, it's expected that mesencephalon's energy requirements must be high. Taking into account that glucose is source of biomass and not of energy; the explanation of the substantia nigra location and function seems obvious: a complementary source of energy.

Thereby the main function of Melanin in the substantia nigra, in the locus ceruleus; in the inner ear; in the eye, in the skin, etc., is the energy production. And by the analogy with the process in plants was termed by our team as Human Photosynthesis.

3 Melanin, the Human Chlorophyll

3.1 Melanin Functions

Are the already described functions of melanin in the skin, the midbrain, the eye, and in the body all? As a merely sunscreen, also as a stigma from ancient times that trend to disappear, some other are controversial, as its antioxidant properties, because under

certain conditions, as in elevated iron levels; melanin behavior is pro-oxidant. So far, the main reluctance to confer to melanin molecule some biological significant function is her unique, extraordinary, long lasting stability.

The melanin molecule is the same one in every single cell of our organism. Location is not important because the molecule is essentially the same, perhaps the size of the granule, molecular orientation, and amount; can be different; however, the main function is the same one: energy production.

3.2 Energy definition

Nobody knows what energy is, is it a line? Is it a circle? Is it a coma? Is it a wave?

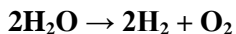
Energy is practically anything that produces some kind of change. It is an inherent property of the mass or vice versa. Energy and mass cannot be separated. We could say that any change into the cell or tissue, requires energy, even the minute one. No one biochemical reaction inside the cell can take place if not exist previously enough free chemical energy available.

3.3 Brief Description of how Human Photosynthesis was Found

In 1990, during a study about the three main causes of blindness, we found a previously unknown reaction that occurs inside the melanin molecule:



It is amazing, because is something unique in Nature. The closest reaction already well-known is this one:



being considered the most important chemical reaction in the world because is the first step in the food chain, and occurs in the chlorophyll of the plants leaves. However the process in melanin constitutes nothing less than the beginning of life. In plants, the dissociation of the water molecule happens in just one way, so is irreversible. In melanin, astonishingly the reaction occurs in both senses. There is nothing similar of Natural or artificial origin.

In plants the dissociation of the water molecule process occurs in plants leaves only during day light time, however, in our body happens night and day, uninterruptedly. The plants' chlorophyll uses blue and red light, the extremes of the visible light; meanwhile melanin has, again; the astonishing capacity to absorbs the totality of electromagnetic spectrum, this is from radio waves to gamma rays; thereby is the reason for which melanin is considered the darkest substance man has ever known. Melanin has the astonishing capacity to absorb any kind of energy, dissipating them in an extraordinary, unique non-irradiative form: the dissociation of the water molecule and its consequent re-formation.

3.4 Melanin Location and Function in the Mid-brain

The substantia nigra, strategically placed in the midbrain, whose function cannot be explained so far; being misleadingly described in medicine's text books as follows: "melanin is a by-product of metabolism of dopamine" and is a sentence that requires to be modified as soon as possible in order to correct this collective mistake; and must be rewritten: "taking into account that the main function of melanin in the human body is

energy production, through the transformation of photonic energy into free chemical energy by means of the dissociation and re-form of the water molecule; being obvious that is a relay station of energy for mesencephalon, a highly complex structure with many functions and structures as cells, synapsis, axons, dendrites forming conglomerates termed as nucleus; besides that is relay and pass station of several neuronal pathways that requires energy in constant way and in huge amounts, not only to afford the thousands of simultaneous biochemical reactions, known and unknown; thus every single one requiring energy at the beginning, along; and thereafter; and even to keep the shape". Melanin releases energy symmetrically, spreads out in all directions, like a growing spheres arising from a melanin center [9].

The growing spheres coming from melanin are alternates and successive, and in accordance with the Solis-Herrera Cycle, we have:



So one wave will has a high content of diatomic hydrogen and oxygen, whereby the next one (and the previous wave) is constituted by re-formed water molecules and a flow of high energy electrons, that are defined as those electrons whose probabilistic cloud is far away from nucleus than electrons of low energy. There are differences between the energy carried by diatomic hydrogen and the energy of the electrons, by finally is energy and both are useful and important for the cell function since the beginning of times.

4 Figures and Tables

Table 1: Differences and similarities between Chlorophyll and Melanin

Molecule	Chlorophyll	Melanin
Water dissociation	Yes	Yes
Take up energy from light	Yes	Yes
Visible light	Yes	Yes
Invisible light	No	Yes
Take place during day time	Yes	Yes
Take place during night	No	Yes
Re-form the water molecule	No	Yes
Occurs inside cell	Yes	Yes
Occurs outside cell	No	Yes
Produces H2	Yes	Yes
Produces O2	Yes	Yes
Produces high energy electrons	No	Yes
Could be the origin of life	No	Yes



Figure 1: Schematic representation of a coronal section through mid-brain

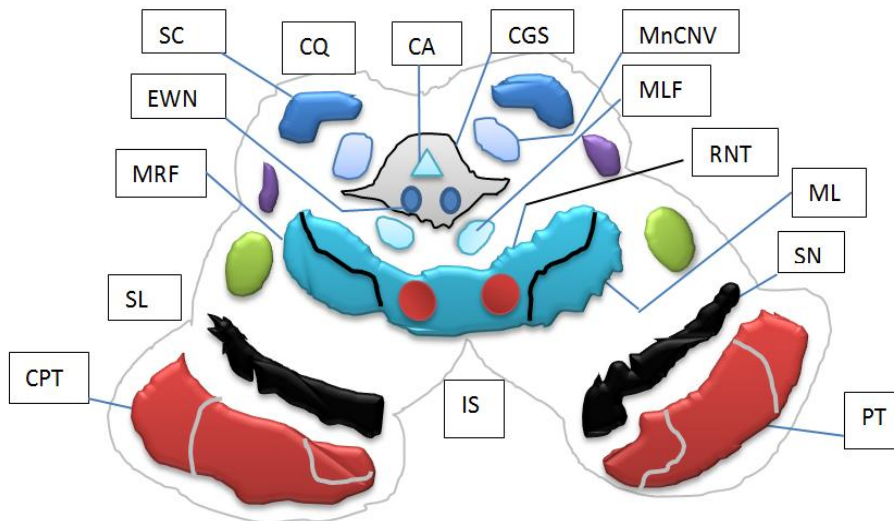


Figure 2: CQ: Corpora quadrigemina. CA: Cerebral aqueduct. CGS: Central gray stratum. IS: Interpeduncular space. SL: Sulcus lateralis. SN: Substantia nigra. RNT: Red nucleus of tegmentum. MLF: Medial Longitudinal Fasciculus. EWN: Edinger-Westphal nucleus (III nerve). ML: Medial Lemniscus. MRF: Mesencephalic reticular formation. SC: Superior Colliculus. MnCNV: Mesencephalic n. CNV. CPT: Corticopontine tracts. PT: Pyramidal Tract

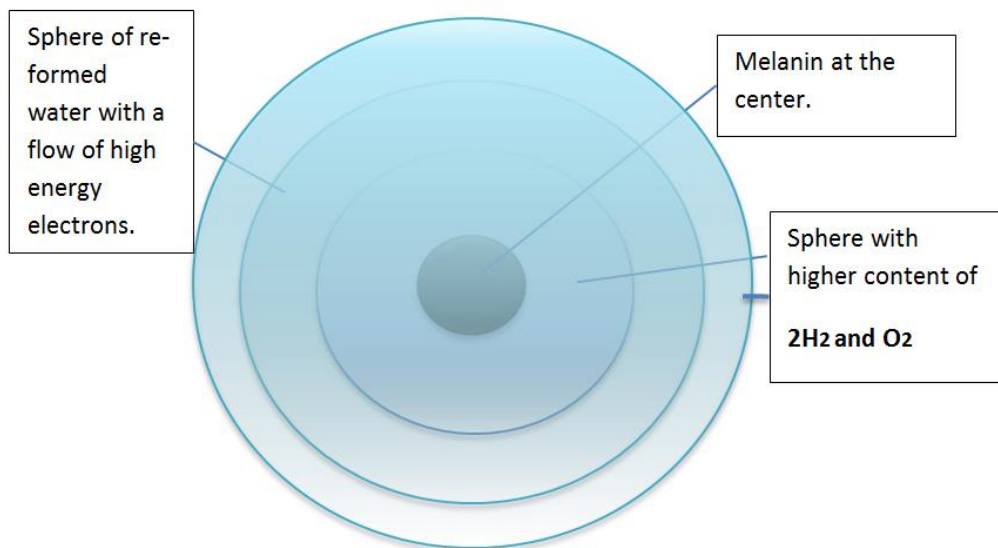


Figure 3: Melanin releases energy symmetrically, spreads out in all directions, like a growing spheres arising from a melanin center , and could be represented as hereby above



Figure 4: The mesencephalon is entirely imbued by the energy that coming from melanin, night and day; all the life; and can be schematized as hereby above. Notice that energy coming from both sides

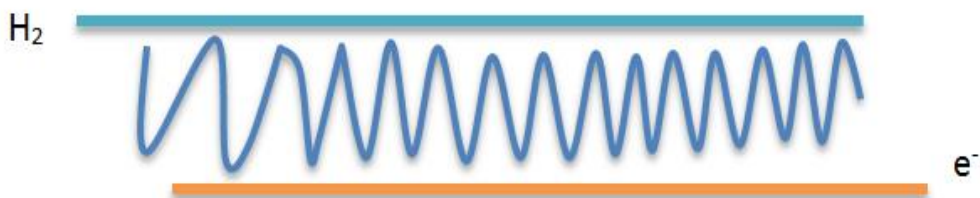


Figure 5: Differences among the physical and chemical characteristics of the energy coming from melanin

5 Conclusions

The balance between energy and biomass is the hallmark of the life and the Central Nervous System is not the exception, therefore an adequate function of the mesencephalon requires the right dynamic balance between energy (from melanin) and biomass (from glucose).

The source of energy must be constant, otherwise the cell die in seconds. The processes are not symmetrical in time, because, as any other chemical reaction; are influenced by reactant concentrations, temperature, pressure, amount of light, etc.

5.1 Comment

Neuro-melanin avidly chelates metals [10] as zinc, copper, manganese, chromium, cobalt, mercury, lead, and cadmium; in addition, it binds iron particularly strongly; and these heavy metals induces an imbalance in the turnover rate of water dissociation and re-formation due to hydrogen, in presence of metals, works with -1 . Neuro-melanin can also accumulate chlorpromazine, haloperidol, and imipramine, thereby contributing to the impairment in the output of the energy coming from melanin.

The eukaryotic and so neuronal cell is so sensitive to major fluctuations in the levels of free chemical energy available, therefore, is congruous that high concentrations of iron and other non-alkaline metals are present in patients with Parkinson's Disease [11].

Microinjections of MPTP (1-methyl-4-phenylpyridinium) accumulates in dopaminergic neurons, and as MPP⁺ is concentrated in mitochondria where inhibits complex 1 reducing ATP generation and causing increased free-radical production and subsequent neuronal death.

The herbicide paraquat has a molecular structure similar to that of MPTP, and has been proposed as a Parkinson's disease inducing agent. The pesticide is accumulated in neuro-melanin containing nerve cells, where it appeared that the neuro-melanin adsorbed intra-neuronal paraquat, protecting the neurons from consequent damage [12], but this biological inactivation has a cost in the efficiency of melanin as energy source that sooner or later will be manifested clinically as some kind of midbrain malfunction.

When this fundamental function of melanin as source of energy is impaired, then the highly complex structure and function of the mid-brain developed by nature along billion years will go into molecular chaos firstly, and thereafter signs and symptoms of some type

of midbrain syndrome could develop.

In any system, the generalized failures are characteristic of low energy levels, therefore the mesencephalon malfunctions usually involves several functional units.

The locus ceruleus (the dark blue spot) could be considered as the equivalent to the substantia nigra in the pons area. It is a complementary source of energy given the shape, number of structural elements, location and function of the anatomical region. It is the principal site for brain synthesis of norepinephrine (noradrenaline) so energy requirements are higher.

Some of the functions influenced by this system are: neuroplasticity, emotions, attention, memory, arousal and sleep-wake cycle; posture and balance, behavioral flexibility, behavioral inhibition, and stress.

The locus ceruleus impairment has been described in Rhet syndrome, Parkinson's disease, progressive supra-nuclear palsy, Pick disease and Down syndrome. There is up to 70 % of locus ceruleus neurons loss in Alzheimer's disease [13].

Albinos, in spite have lack tyrosinase enzyme, display normally pigmented substantia nigra [14]. Albino condition is not the complete loss of melanin; it is just partial due to lack tyrosinase enzyme.

It is not by chance that the pigmented neurons of the substantia nigra and locus ceruleus are typically lost in Parkinson's disease [15], Alzheimer's Disease, Huntington's Disease and others epidemiologically important illnesses. Thereby, the relation between neuronal vulnerability and the presence of neuro-melanin, a fact previously unexplained; now is clear at light of the finding of the human photosynthesis. Finally, based in our finding of the intrinsic property of melanin to split and re-form the water molecule, from now in ahead is possible to integrate the structural aspects of melanin with morphological, functional and pathologic findings.

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