# The Unsuspected Intrinsic Property of Melanin to Transform Light into Chemical Energy and the Seed Growth

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Additional information is available at the end of the chapter

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**Abstract**

Seeds are very important part of the world's diet, contributing to half of the global per capita energy intake. Thereby, their study has a substantive relevance, reflected by numerous yearly publications. However, mysteries remain about the main molecular mechanisms involved in germination and dormancy. Seed is a completely independent living thing, and in suitable conditions, hatches and generates a new adult plant completely, identical to which they gave rise. And to do so requires only light and water in certain proportions. Theoretically, the seed has reserves of nutrients that allow it to grow, until their so-called autotrophic features allow them to establish itself as a self-sufficient organism. So far, the above cannot be explained adequately, we only have abundant theories that come and go. However, our finding of the intrinsic property of melanin is that it transforms the visible and invisible light to chemical energy through the water molecule dissociation and marks a before and an after process in the study of the germination of the seeds. Nutrients that can be found in a seed not only provide energy but also elements to be biomass, that is, mainly carbon chains of different lengths and combinations, which eventually constitute the backbone of more than 95% of biomolecules. The chemical energy that the seed requires to carry out the highly complex chemical reactions necessary for hatching is taken from water, dissociating it through melanin.

**Keywords:** melanin, chlorophyll, water dissociation, dormancy, germination, energy

## 1. Introduction

Life in plant is cyclical, like in human beings. The seed in plants can be considered the starting point; thereby, seed biology is one of the most extensively researched areas in plants physiology. However, two fundamental questions remain: how does the embryo emerge and how is embryo emergence blocked?

It seems not be advantageous for a seed to germinate freely. Thereby, seed dormancy is a mechanism that optimizes the germination. However, little progress has been made toward the understanding of dormancy, besides we do not know the defining events in germination.

The threshold stimulus that initiates a common signal transduction cascade that coordinates diverse cellular responses is unknown and varies widely among individual seeds. Characteristically, germination commence with the uptake of water by the quiescent dry seed. The metabolic activities of the imbibed dormant seeds are only subtle different from those of nondormant seed. The main difference is that the radicle (the embryonic axis) fails to elongate.

Dormancy phenomenon has no clear definition, and it differs among species. When the embryo is constrained by surrounding structures, the phenomenon is known as coat-enhanced dormancy. Interestingly, embryos isolated from these seeds are not dormant. So far, dormancy is a poorly understood phenomenon.

The release of dormancy and completion of germination occur within a relatively few cells associated with the embryonic root axis. However, even the presence of apparently nonresponding cells in the axis and other seed parts helps in a successful germination.

The release of dormancy can be triggered by a variety of known and unknown environmental and chemical stimuli, but the presence of water is unavoidable. Initially, the uptake of water by a mature dry seed is rapid, followed by a plateau phase. A further increase in water uptake occurs only after germination is completed.

The influx of water shows peculiarities as the water inside the cell is pure; thereafter, the dormant cell membranes have an immediate and rapid leakage of solutes and low molecular weight metabolites into the surrounding imbibition solution; however, the processes initiated by the entrance of surprisingly clean water have a certain order, and they are not at random at all and have a definite sequence.

The membranes return to their more stable configuration after a short time of rehydration, and solute leakage is curtailed. Therefore, it is not by chance that it occurs, instead, a highly ordered sequence of events happens; for instance, the amount of *N*-acetyl phosphatidylethanolamine, a phospholipid compound with membrane-stabilizing properties, increases as does that of the corresponding synthase.

Upon imbibition by this pure water, the quiescent dry seed resumes metabolic activity. It is hard to explain how the sole reintroduction of clean water during imbibition is sufficient for metabolic activities to resume, and in matter of hours, a full metabolic status is achieved.

The word "metabolism", which means continuous change, is the result of different processes that occur in a very coordinated manner, both in space as well as in time and place. In no way are the results by chance. And to this we add the energy required so that metabolism can occur, then we try to find a source of energy which is capable not only of producing changes, but also in a proper, orderly, and complex fashion. We can get the answer in the melanin.

## 2. Melanin, the great transducer

The so-called germination comprises a chain of concatenated events, and by no means they are isolated and all are connected among themselves in a way that we do not understand. But the unsuspected intrinsic capacity of melanin becomes the visible and invisible light energy chemical through dissociation and subsequent reformation of the water molecule. Discovered by our team in 2002, it comes to fill a very important gap in the knowledge of seed biology.

So far, melanin has been considered as the perfect protection against UV-induced photodamage [1]. It is an absorbent filter that reduces the penetration of UV through the epidermis. Other significant properties of melanin already described in the literature are its functions as a free radical scavenger and superoxide dismutase that reduces reactive oxygen species (ROS) [2].

Melanin, under certain circumstances, can also have toxic properties [3], at least theoretically. However, more than 120 genes have been shown to regulate pigmentation in mammals. On the other hand, melanin's basic structure is poorly defined. Melanins are electron acceptors and charge exchange is considered a major binding force in many reactions.

Much has been written about complex properties of melanin, but the mechanisms of action were more theoretical than real, since some properties of melanin seem to oppose each other. But the hitherto unknown property of melanin transforming light into chemical energy breaks the paradigm in which it corresponds to their biological function.

Energy production is the new feature that we now know in melanin, and it is the same everywhere, for example, on the outer layers of the seeds (episperma) and fruits (**Figures 1–9**).

**Figure 1.** Melanin is present in all the seeds. The difference in hue depends on the concentration of the molecule, granule size, orientation in the molecule, and type of structures that surround it. Photograph shows the high concentration on mature fruit of avocado (American Persea Mill) peel, even it seems that higher concentration of melanin results in greater fruit and seed size, as it is conceivable that the higher amount of melanin means greater availability of chemical energy. On the right side of the picture, we observe tamarind seed (*Tamarindus indica*) whose brown color is also due to the melanin.

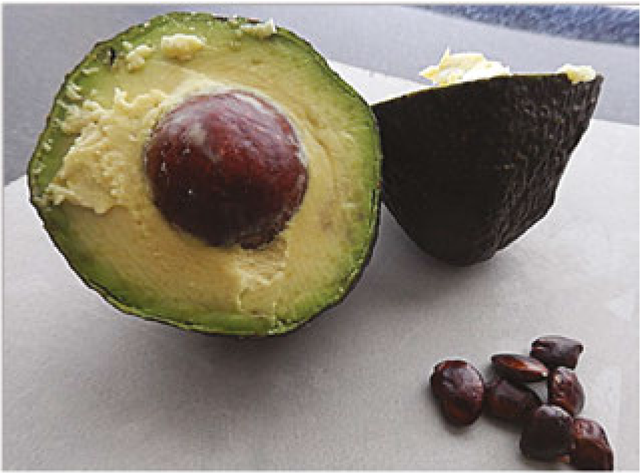

**Figure 2.** Melanin must be present in all cells. Because of it, cells are capable of producing their own chemical energy through dissociation of water molecule, which appears as a universal mechanism. Melanin is concentrated in the areas of increased demand for power, for example, around the nuclei of the cells, and in seeds, in areas of high metabolic demand (episperm). Typically, melanin tends to be close to light energy sources (i.e., sunshine), and on the other hand, the concentration of melanin also functions as a regulator of the amount of light that should reach the inside of the body; in this case, mature avocado fruit and tamarind seeds.

**Figure 3.** The superficial part of the outer portion of the mature fruit of the avocado is very dark, because of its high concentration of melanin, which indicates that, on the one hand, it transforms significantly visible and invisible light into chemical energy, and on the other hand, regulates the amount of light that must pass through and reach the inner parts of the fruit. Outer covering of the seed of the avocado (episperma) presents a very similar color, and thereby, similar melanin content to the tamarind seeds.

**Figure 4.** Outer covering of the seed of tamarind (left) and avocado (right)—episperma—present very similar colorations. The melanin present in these structures transforms the light into chemical energy, and also regulates the amount of light that must pass through and reach the deep parts, which also require light, either visible or invisible.

**Figure 5.** The outer coat of the avocado has melanin of high molecular weight (dark melanin or eumelanin), and the outer coat of the seed (episperma) has melanin of low molecular weight (pheomelanin). In both cases, the function of melanin is the same, chemical energy production.

**Figure 6.** Eumelanin in the outer casing of the avocado, in addition to producing energy, functions as a regulator of the amount of visible and invisible light that penetrates the inside of the fruit, because it must be within a certain range; on the other hand, the pheomelanin of the seed allows a greater light to pass so that is still maintained within the optimal range.

**Figure 7.** Outer dark color of various brown tones of episperma indicates the presence of melanin. Pulposus green content allows us to infer the presence of heme groups, which are also capable of dissociating water molecule, but unlike the melanin, make it irreversibly.

**Figure 8.** The grooves that are seen on the surface of the seed, covered and merged in brown tissues (melanin), transport liquids whose nature is not well understood, chemical processes occur inside them even, as in the SAP from the trunk of the tree. But two of the mysteries seem to be solved with melanin, the energy needed to move the fluid and the chemical energy that drives very tidy reactions happening inside these channels, because in both cases, the chemical energy required, no doubt comes from the melanin.

**Figure 9.** Detail of the groves on the surface of the avocado seed—episperma.

Melanin is able to dissociate the water molecule and also reshapes it. That is, liquid water transforms it into its gaseous components, hydrogen and oxygen, releasing both in molecular form. In this phase, the energy that is released is transported by hydrogen, which is an observed fact in the entire universe. Hydrogen is the main carrier of energy, whereas oxygen is toxic at any concentration.

The belief that our body combines glucose with oxygen to get energy no longer holds since the discovery of diabetes. On the other hand, our body has handled the glucose since the beginning of time, but when the conditions are true, diabetes occurs. When chemical energy levels are not adequate, the body cannot do what it does, which it has been doing since millions of years and millions of times.

In the seed, what happens is that the melanin that is mainly in the outermost layers begins to absorb water and begins to dissociate and re-form, and as a result water that forms inside the seed is pure water because it comes from the recombination of the gases.

But not just the presence of water, but also the levels of hydrogen and oxygen inside the seed begin to rise, and the energy that carries the hydrogen starts to promote each and every chemical reactions that take part in the germination process.

The energy that comes from the melanin is surprisingly consistent and accurate, and hence their effects on seed are also consistent and accurate.

The reaction occurring inside the melanin can be written as follows:

$$2H_2O \leftrightarrow 2H_2 + O_2 + 4e^- \quad (1)$$

For every two molecules of water that is reformed, four high-energy electrons are generated [4].

## 3. Seed germination, resolved

Therefore, the long-lasting mystery of the germination of the seed seems to be resolved, and they are as follows: when the amount of water and light is adequate, the chemical energy that emanates from the melanin will be enough to promote each and every one of the chemical reactions that occur inside the seed, and this will help in the germination process. But when the amount of water and light is not adequate, the energy that emanates from the melanin will not be enough, and as a result it will only maintain the shape of the seed, but cannot hatch until the levels of chemical energy to the interior of the cell are within a range that can be considered optimal.

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## 4. Is melanin a natural fertilizer?

It is surprising to find nature's insistence to place melanin practically in all the seeds, at different tissues, and different concentrations (**Figures 9–13**). The reason for this is chemical energy production.

**Figure 10.** Tamarind seed, 16×. Brown color is given by the melanin.

**Figure 11.** Tamarind seed, 16×. When the external coat is slightly removed a darkest coat of melanin is perceived.

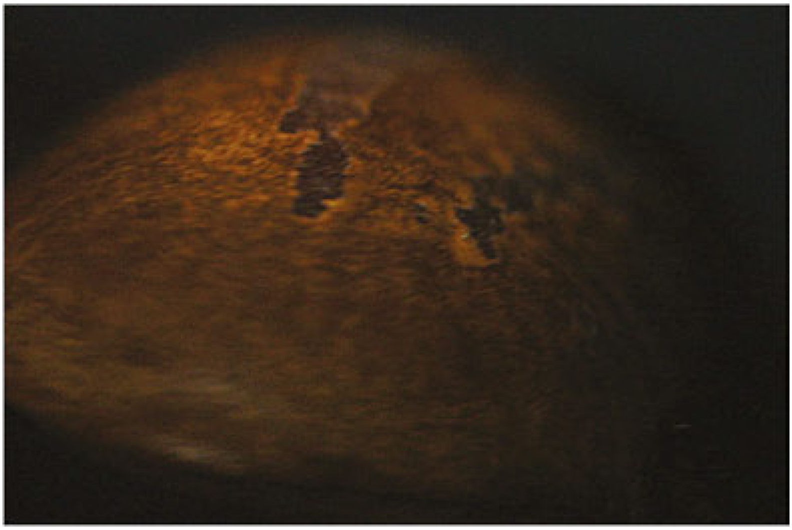

**Figure 12.** Tamarind seed. With dim light, the melanin is clearly observed and its color shows a resemblance with the eye iris color.

**Figure 13.** With brightest light, the color of the tamarind seed registered by the camera is almost yellow.

In order to perform its function to generate chemical energy, melanin absorbs visible and invisible light, which is the darkest substance known; and it dissipates the energy by dissociating the water molecule [5], which is reformed almost immediately, starting a very consistent and reliable cycle, while both light and water are still available. The energy that is released due to water molecule breakdown is transported by the diatomic hydrogen.

If we could see how hydrogen bubbles emerge from the melanin, one could observe symmetrically formed and drawn hydrogen bubbles in all the directions (**Figure 14**).

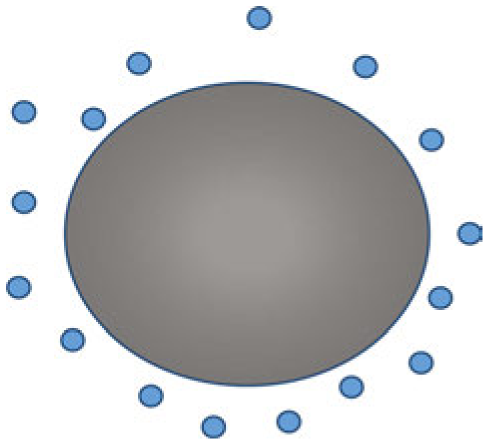

**Figure 14.** Melanin in dark, and molecular hydrogen in blue, drawing as small bubbles.

Something similar happens in seeds too. However, as melanin is arranged in layers, that is, in episperma, the bubbles displacement occurs outside and inside of the seed (**Figure 15**).

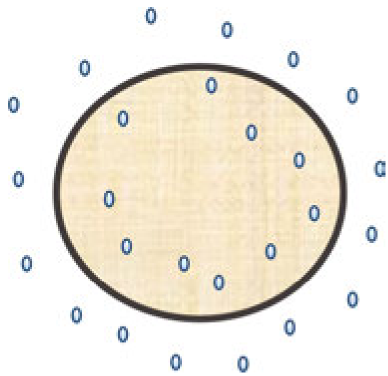

**Figure 15.** The dark circle around the seed is the melanin layer representation, and the bubbles of blue pale color are the representation of the molecular hydrogen.

The hydrogen that penetrates the inside of the seed has the important function of activating the complex biochemical machinery of germination; driving each of the chemical reactions involved in precise, consistent, and relentless form.

However, the hydrogen bubbles that go into surroundings of the seeds carry out an important function, that is, promote changes in the immediate environment of the seed, which in turn promotes germination, that is, the development of other forms of life, for instance, fungi (**Figures 16–19**).

**Figure 16.** The seed of the tamarind, when not in adequate conditions of water and light, remained almost unchanged, retaining a surface similar to the stored seeds.

**Figure 17.** However, when the tamarind seed is in right conditions, by principle of accounts, straightening (polarity) immediately increases its volume, and begins to cover a milkweed (fungi), which also form a part of the cycle (Rhizome).

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**Figure 18.** In this photograph, the elongated epicotyl is more visible. Tamarind has hypogeal germination.

**Figure 19.** In this other specimen, the elongated epicotyl forming the hook is clearly visible.

According to Darwin, although there are more than one million species, there is just one life. For us it means that life originates from the dissociation of the water molecule. Molecular hydrogen being the important part as it is the carrier of energy for excellence in nature, not only on Earth but throughout the universe, and therefore the seeds are no different.

The formation of symmetrical hydrogen bubbles in all the directions by melanin (**Figure 14**) produces a high energy area in its immediate surroundings, so it activates not only the mysterious metabolic processes involved in germination, but produces a beneficial effect on microorganisms that live in the soil, which also play a substantive role in the cycle.

In addition to being the carrier of energy most used in nature, molecular hydrogen is the best antioxidant that is known, because it is able to reduce oxygen into water.

The growth of fungi on the surface of the seed (**Figure 17**) is a clear example of the effect it has on life (in all its forms). The molecular hydrogen and its precious cargo of energy that was injected at the time of the dissociation of the water molecule is very useful, as the seed uses chemical energy in many ways. And it is not any kind of energy, because the melanin generates it in a very precise, consistent, and relentless form, and it occurs both day and night. And this is also reflected in the metabolic processes of the plant, which also are precise, consistent, and incessant, and they occur both day and night.

It was simply the chemical energy with which the seed was created over billions of years of evolution. If we compare the chemical energy that emanates from the melanin with another type of energy, for example, heat, which is a very messy form of energy, germination does not occur.

Even if we compare the energy that comes from the melanin with the energy of the Sun, germination cannot take place from the energy of the Sun. Germination needs both visible and invisible light, which is "conditioned" to transform by a transductor. And in the case of life, melanin seems to be the one which carries out such adaptation of solar energy. As when light energy is too strong, melanin decreases it, and when it is scarce, melanin elevates it. Seems that melanin thrives on pressure.

Melanin is therefore a natural fertilizer, which not only fertilizes the seed itself, but also the nearby environment that surrounds it, optimizing the possibilities of germination.

## 5. Conclusion

Any chemical process that is subject to a consistent and accurate energy will result in consistent and accurate products.

Life is a continuous process and atoms which are influenced by the melanin begins to behave in a way *sui generis*, and the molecules that are formed and continue to receive chemical energy that emanates from melanin also behave in a very different way than as they would under other conditions, for example, with another type of energy—heat.

And the same might be said for each and every one of the molecules that are continuously formed and grow, becoming more and more complex. And surprisingly, the fundamental chemical energy remains the same, as this is not created or destroyed. But the complexity of the compounds that are formed under the influence of melanin appears to be exponential and at the same time surprisingly exact, because it is repeated over and over again and over millions of years.

Seeds, considered for some authors as mysterious genetic capsules [6], contain many secrets that are yet to be revealed. Mechanisms by which seeds undergo extreme desiccation without losing viability remain unclear. Further, the network of genes conferring on seeds the ability to remain dormant has yet to be fully elucidated.

As the global population exceeds more than 7 billion, and seeds providing more than 70% of the world's caloric intake, the efficient production of seeds is becoming ever more important. Thus, the determination of the genetic and biochemistry of seeds, with the main aim of enhancing yield and nutritive values of seeds, are essential steps. Recently, the utilization of seeds as a source of biofuels to replace fossil fuels in developed countries significantly worsens the problem of adequate food production.

While almost every year new genomic sequences from plants are published, the impact on crops has not been as important as expected, as seed germination seems as a response with a simple output but requiring multiple inputs. Seed sense fluxes in many different environmental factors, and appears to have the capacity to analyze them in a holistic way and to determine whether they germinate or not.

It seems that the presence of an adequate quantity of water and electron flow should take numerous metabolic switches, but in a very precise and complex way, both in space, time, and location. And so much so, that despite the best efforts of researchers in the area, the process of maturation and germination of the seed has not been deciphered yet.

## 6. Perspective

Despite significant progress in seed biology, basic questions still need to be answered. Further, it is important to translate existing knowledge into agricultural outputs [7].

**Figure 20.** Eye iris. The surface and color of the iris has a remarkable resemblance with the surface and color of several seeds. The color of the eye iris is also due to melanin content.

The insistence of nature in melanin in all forms of life (**Figure 20**) is a message that is very important and essential from which we must learn as much as possible. Let us remember that nature only insists on things that are important and relevant.

And we can say that with the discovery of the intrinsic capacity of melanin to transform the visible and invisible light to chemical energy through the water molecule dissociation, the best is yet to come.

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