

Luciferase as a research technique for biological processes

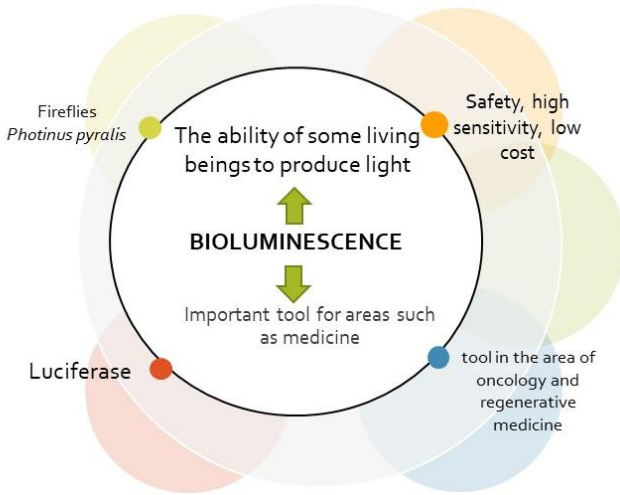
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Graphical Abstract	Abstract.
	<p>Abstract.</p> <p><i>Bioluminescence is the ability of some living beings to produce light thanks to chemical reactions in these organisms. The bioluminescence of fireflies has been used as an important tool (analytical techniques) within various studio fields. Luciferin (substrate for providing bioluminescence) is encoded by specific DNA sequences. Thanks to genetic engineering these sequences have been copied in such a way that they can be used in tissues for research purposes or for purposes such as cancer treatment. This article will talk about how light is formed from fireflies and how it is used in various applications.</i></p>

Introduction

The bioluminescence of fireflies has been used as an important tool (analytical techniques) within various fields of study. The emission of yellow green light from fireflies is generated by the catalytic conversion of chemical energy enzymes using luciferin in light as a substrate. The enzyme is called luciferase and the substrate luciferin. As mentioned, firefly luciferin and luciferase is used as an analytical study tool. The mostly studied luciferase enzyme is from the organism *Photinus pyralis* of North America.

The reaction carried out for bioluminescence to occur requires adenosin-5'-triphosphate (ATP) as a co-factor. ATP is the universal energy of living organisms, ATP luciferin-luciferase detection trials have

become standard methods for detecting microbes in food and in the pharmaceutical industry as clinical settings; In addition to this, luciferin-luciferase has been a convenient tool for the distinction of living cells and dead cells.

One advantage of bioluminescence compared to fluorescence is that the former does not require an excitation light source, the images are generated with low background signals.

The reaction mechanism for bioluminescence production requires ATP, Mg(2+) and molecular oxygen, taking within the entire reaction oxidative decarboxylation of luciferin, acetylation, finally a photon of visible light is released, which is visible as the bioluminescence coming from the firefly.

For the analysis of biological processes, colors other than the bioluminescent yellow-green color are necessary for both in vivo and in vitro assays. Thus, the use of luciferase from other species and/or mutations of the enzyme constitutes strategies for the emission of light with different colors from the reaction of luciferin-luciferase. Tripluc® is a commercial tricolor luciferase consisting of a system developed by mutant luciferases, said system consists of green (550 nm), orange (580) and red (630). The marketed luciferase genes can be classified into two types. The first type are derived from marine organisms, these structures are categorized as imidazopiradinones; the second type include firefly luciferase genes. The last type are commonly chosen for in vivo testing by bioluminescent imaging (BLI) giving a wavelength emission in the range of 460-630 nm, a strategy to modulate the wavelength emission is to alternate substrates in the structure.

Thus modifying the structure to obtain a high wavelength range of the luciferase-catalytic is an advantage since this is possibly an important factor that determines the maximum wavelength. Ideally the variability that can be obtained with the modification of the structure can be applied as immobilized marks for specific molecules for multiple tests using luciferase, emitting different wavelengths.

The application of in vivo images resides in an important tool in the area of oncology and regenerative medicine. The perfect imaging modality should have the following properties: Safety, high sensitivity, without genetic modifications, low cost, etc., it is worth mentioning that not all techniques used in the area of medicine have all the properties these include: X-ray CT, positron emission tomography, MRI. Images by BLI are categorized as optical imaging techniques and these have low-cost, short acquisition and high sensitivity properties for molecular and cellular images.

Conclusions

As mentioned above, luciferin is encoded by specific DNA sequences; Thanks to genetic engineering these sequences have been copied in such a way that they can be used in tissues for research purposes or for purposes such as cancer treatment. The introduction of this protein into hundreds of tissues for expression has helped to perform in vivo processes to understand biological processes.

Biotechnology has required proteins such as luciferase to solve specific problems in human tissues, the usefulness of this protein in the area of medicine is extremely beneficial, the study of proteins involved in avoiding diseases such as Alzheimer's, Parkinson's, or some cancers.

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