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 Scientific Literature Essay

Phosphorus, a vital mineral that can be constructed in the form of inorganic phosphate, also known as Pi for short, is a crucially important macronutrient to a variety of living organisms. The nutrient plays many roles within our cellular metabolism such as the building of ATP formation and regulating energy production and thus is important to maintain proper function of inorganic phosphate within our bodies or such events could lead to incurable diseases as well as impact aging and an organism's lifespan; however, don’t be alarmed! Inorganic phosphate levels can be sustained in the intestinal absorption and are widely distributed in the diet and are hardly regulated by the digestive tract. Additionally, inorganic phosphate homeostasis is controlled by the kidney, which can adjust its capacity to reabsorb inorganic phosphate in response to changes in inorganic phosphate demand.[[1]](#footnote-0) A lack of phosphorus in humans can lead to a plethora of issues in one’s daily life including armenia, overall muscle weakness, burning, and serious confusion. It is a part of our everyday lives and extremely important not only in our bodies but in a lot of the foods we eat for nutrition and sustenance.

Furthermore, inorganic phosphate is a signaling molecule that is becoming more and more significant. It can modify various cellular activities by changing gene expression, protein abundance, and signal transduction pathways in a wide range of cell types. Inorganic phosphate is needed for cell survival and relates to phospholipid structure and metabolism through signaling and energy transfer such as in living organisms such as plants. Similarly, in fungi, for example, inorganic phosphate plays an important role in regulating signal transduction pathways that are used by many phosphate responsive genes that are required for many processes for fungi cell function.[[2]](#footnote-1) Hence inorganic phosphate is a major nutrient required for energy metabolism for all living organisms.

Multilamellar organelles or bodies are membrane-bound cellular organelles and are also known as MLBs for short. Multilamellar organelles range in sizes from 100-2400 nm and are located in many different cell types where the main purpose is lipid storage. They are made from aligned membrane layers with an electron dense core and come together to form many of the cell’s most important features such as the golgi apparatus and thylakoid membranes.[[3]](#footnote-2) Recently, scientists have been looking further at multilamellar organelles through research projects and have developed some interesting conclusions. One such example published by “Chembiochem,” the multilamellar structures are a result of random vesicle generation which leads to an uncontrolled amount of bilayers. The control of the bilayer is vitally important to these organelles, as the random amount could lead to excessive or a complete lack of growth at all.[[4]](#footnote-3) Given that hundreds of bilayers stack on top of each other to make this scientific finding happen the natural perfection of multilamellar organelles is simply quite astonishing.

In the article, “A phosphate-sensing organelle regulates phosphate and tissue homeostasis”, figure two shows different fluorescent imaging panels that all provide evidence for a new multilamellar organelle called PXo bodies. Each panel analyzes different methods that determine whether or not the organelle regulates phosphate. For example, panel A explores the size and shape of these new organelles and looks as if the organelles are quite small in size, yet they vary in shape. Some are circular and tube-like while others are more oval shaped. In the second part of panel A, it appears the orgallege is whole, most likely due to the whole panel color being red. Panels B and C utilized a technique called immunogold labeling to determine where the bodies were present in the cell and is more present in panel C from the extensive amounts of black dots. In panel E, the researchers used an acidic marker called LysoT, which shows up as the color red, and a GFP-PXo, which appears green under fluorescent imaging. In this panel, the green and red do overlap quite a bit, represented by the yellow coloring resulting in the creation of acid. In panel F, the red coloring is now a lysosome marker called Lamp1, and there is not much yellow coloring, if any at all, from the red and green overlapping indicating that there are no lysosomes. Panel G has the red coloring now coming from lipid dye, which shows whether the cell has lipids present or not. In this case it looks like lipids are present from the yellow coloring and overlap of the green and red fluorescence. Panel H does not appear to show that this organelle is part of the golgi even while there is still some yellow coloring; it is a small amount and is not in a specific area of the panel. However, in both panels I and J, glycosylation and phospholipids seem to both be present, since the two panels show a fair bit of yellow. In the last and final panel, K, there are two spots of yellow coloring, so endocytosis would not be present.

In figure three, the researchers used a fluorescent resonance energy transfer or FRET and a model called FLIPPi, sensor for intracellular Pi, to explore levels of inorganic phosphate in the cytoplasms. Panel F displays the average FRET ratios between the normal cell that had AHL, and the cell that had supplemental phosphate added. In the presence of the RNA inhibitor, whose purpose is to change levels of Pi and lower expression of PXo, the data showed just that. For instance, all the AHL normal cells with the inhibitor, PXo-i, and without the inhibitor, Luci, had a higher FRET ratio than the cells that contained the supplemental phosphate added, indicating that the AHL normal cell had low levels of Pi. However, the cells that had the addition of supplemental phosphate had a lower FRET ratio, when inhibitor was present and absent, indicating high amount of Pi in the cytoplasm. When the inhibitor was present, it is displayed that both cell levels, normal and added phosphate, dropped in average ratio causing the levels of Pi to increase. Based on the average ratios the graph provides, and the heat maps shown above them, PXo pumps phosphate into the cell due to the lower values of FRET and the blue coloring in map E, resulting in higher levels of Pi throughout the cytoplasm.

Figure four looks at the number and size and whether or not the organelles change in response to different levels of inorganic phosphate. Panels A and B show that the Pxo bodies look a lot smaller in size in panel B, possibly due to the phosphonoformic acid inhibitor or PFD. Similarly, in panel C the bodies also resembles the small size compared to panel A where no inhibitor is added. However, when they added additional phosphate into the environments the average size of the PXo bodies were larger than the normal average and presences of PFD inheritor. With these numbers, the organelles shown in fluorescent lighting are represented in panel E, F, and G. In panel F, you can see that there are quite a lot of PXo bodies displayed as the color green; however, in panel F those potential organelles decrease quite a bit in number due to the inhibitor. But, when they add in the extra phosphate the organelles begin to flourish more than in panel E with just the normal amount displayed. Based on these two pieces of data, one can conclude that when additional phosphate is added to the intracellular environment of these potential organelles, the organelles tend to thrive in both size and numbers.

 Finally, figure five shows two pie charts, one as the control or normal PXo bodies, and the other with a PFA inhibitor. Based on these two graphs, it is displayed that PE or phosphatidylethanolamine and PC or phosphatidylcholine are the two most common phospholipids. Looking at both graphs, it is shown that PE has the same percentage,35%, when the inhibitor is either present or absent. Comparatively, PC has different percentages between the two graphs; graph D 45% and graph E 39%. Why would PC have a lower percentage when the inhibitor is present? This lower value in graph E could possibly be due to a lower amount of phospholipids in graph E compared to graph D, as represented above the two pie graphs.

 In conclusion, based on all the data collected from the different figures in this article, I am convinced that these PXo bodies form distinct organelles with a unique biochemical function in the cell. This assumption is based on the findings from figure two in the article, where they provide different types of fluorescent imaging panels. Overall, the data did support the hypothesis of how a new organelle that regulates phosphate, as whenever phosphate was added, or there was additional supplemental phosphate in the environment, the orgalleges would thrive and were noticeably present in the data.

References

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