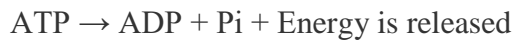


Difference Between ATPase and ATP Synthase

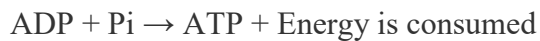
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Key Difference - ATPase vs ATP Synthase

Adenosine triphosphate (ATP) is a complex [organic molecule](#) that participates in the biological reactions. It is known as “molecular unit of currency” of intracellular energy transfer. It is found in almost all forms of life. In the [metabolism](#), ATP is either consumed or generated. When ATP is consumed, energy is released by converting into ADP (adenosine diphosphate) and AMP (adenosine monophosphate) respectively. The enzyme which catalyzes the following reaction is known as ATPase.



In other metabolic reactions which incorporate external energy, ATP is generated from ADP and AMP. The [enzyme](#) which catalyzes the below-mentioned reaction is called an ATP Synthase.

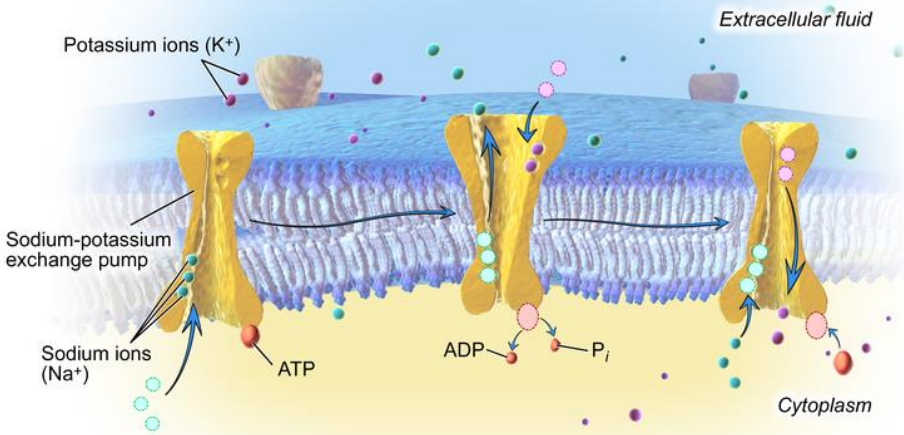


So, the **key difference** between ATPase and ATP Synthase is, **ATPase is the enzyme that breaks down ATP molecules while the ATP Synthase involves in ATP production.**

What is ATPase?

The ATPase or adenylypyrophosphatase (ATP hydrolase) is the enzyme which decomposes ATP molecules into ADP and Pi (free phosphate ion.) This decomposition reaction releases energy which is used by other chemical reactions in the cell. ATPases are the class of membrane-bound enzymes. They consist of a different class of members that possess unique functions such as Na⁺/K⁺-ATPase, Proton-ATPase, V-ATPase, Hydrogen Potassium–ATPase, F-ATPase, and Calcium-ATPase. These enzymes are integral transmembrane proteins. The transmembrane ATPases move solutes across the biological membrane against their concentration gradient typically by consuming the ATP molecules. So, the main functions of the ATPase enzyme family members are moving cell [metabolites](#) across the biological membrane and exporting [toxins](#), waste and the solutes that can hinder the normal cell function.

A very important example is [Sodium/Potassium](#) exchanger ATPase (Na⁺/K⁺-ATPase) that involves in maintaining cell membrane potential. The Hydrogen/Potassium ATPase (H⁺/P⁺-ATPase) acidifies the stomach which is also known as “gastric proton pump.” Some of the ATPase enzymes are working as cotransporters and pumps. Active transportation is the movement of molecules across a membrane from lower concentration region to a higher concentration region of molecules against a concentration gradient. Secondary active transportation involves the electrochemical gradient. The cotransporters are used in the secondary active transportation of molecules. The Na⁺/K⁺-ATPase is a well-known cotransporter which causes the net flow of charge.



The Sodium-Potassium Exchange Pump

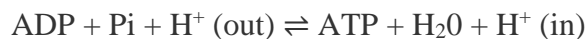
Figure 01: ATPase (Sodium-potassium pump)

There are different ATPases. They differ in function, structure and the ions they transport. ATPases are classified as bellow,

- **F-ATPase** - It is found in bacterial [plasma membranes](#), [mitochondria](#), and chloroplast. The water-soluble part of F₁ section hydrolyzes ATP.
- **V-ATPase** - It is found in the [eukaryotic vacuoles](#). It catalyzes ATP hydrolyzing in [organelles](#) like proton pump of [lysosome](#) to transport solutes.
- **A-ATPase**- [Archaea](#) has A-ATPase. They function like F-ATPase.
- **P-ATPase**- It is found in [bacteria](#), [fungi](#) and eukaryotic membranes and organelles. It functions as ion transporters across the membrane.
- **E-ATPase**- A cell surface enzyme involves hydrolyzing NTPS including extracellular ATP.

What is ATP Synthase?

This is the enzyme that creates ATP (energy storage molecules). The overall reaction that catalyzing ATP synthesis is as bellow,



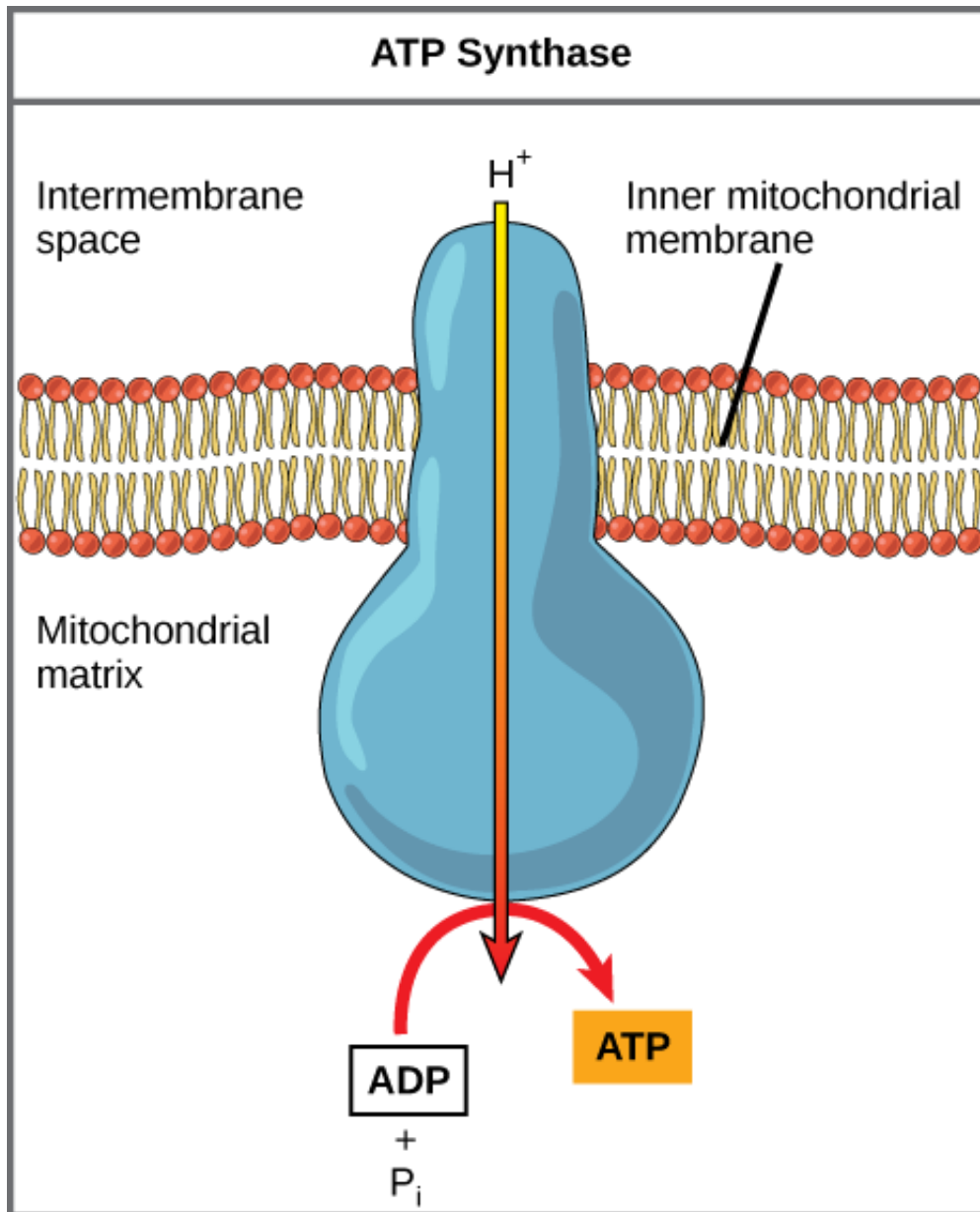


Figure 02: ATP synthase

As this reaction is energetically unfavorable (ATP from ADP) it takes place in the reverse direction. It does have major two regions in the enzyme structure. This has a rotational motor structure allowing ATP production. They are F_1 (fraction 1) region and F_0 (fraction zero) region. Because of this rotational mechanism (molecular machine) the F_0 region drives the rotation of F_1 region. F_0 region has C-ring and other subunits like a, b, d and F_6 . F_1 region has alpha, beta, gamma and delta subunits. F_1 and F_0 collectively create a pathway for proton movement across the membrane. They mainly produce more ATP molecules in electron transport chain through oxidative phosphorylation.

What are the Similarities Between ATPase and ATP Synthase?

- Both regulate the number of ATP molecules in the cell.
- Both are multi subunits enzymes.
- Both can regulate the movement of molecules across the membrane.
- Both are heavy molecular weight enzymes.
- Both are enzymes that are protein in nature.

What is the Difference Between ATPase and ATP Synthase?

| ATPase vs ATP Synthase | |
|---|---|
| ATPase is the enzyme that breaks down ATP molecules. | ATP Synthase is the enzyme which involves ATP production. |
| Reaction | |
| ATPase catalyzes the energetically favorable reaction (ATP to ADP). | ATP Synthase catalyzes the energetically unfavorable reaction (ADP to ATP). |
| Free Phosphate ion | |
| ATPase generates free phosphate ion. | ATP Synthase consumes free phosphate ion to produce ATP. |
| Motor rotor mechanism of ATP breakdown | |
| ATPase does not show the “Motor rotor mechanism” of ATP breakdown. | ATP Synthase shows the “Motor rotor mechanism” of ATP production. |
| Reaction Type | |
| ATPase is involved in exothermic reactions. | ATP Synthase is involved in endothermic reactions. |

Summary - ATPase vs ATP Synthase

ATP production and hydrolyzing processes are found in almost all forms of life. In the metabolism reactions either they are consumed or regenerated. When they are consumed, energy is released. ADP (adenosine diphosphate) and AMP (adenosine monophosphate) are produced during the ATP breakdown. The enzyme catalyzing the ATP breakdown reaction is known as ATPase. In other metabolic reactions, ATP is generated from ADP and AMP. The enzyme

catalyzing the ATP production reactions is called an ATP Synthase. This is the difference between ATPase and ATP Synthase.

Reference:

- 1.“ATPase.” Wikipedia, Wikimedia Foundation, 6 Nov. 2017, [Available here](#)
- 2.“ATP synthase.” Wikipedia, Wikimedia Foundation, 9 Nov. 2017, [Available here](#)

Image Courtesy:

- 1.'Blaesen 0818 Sodium-PotassiumPump'By Blaesen.com staff (2014). "Medical gallery of Blaesen Medical 2014". WikiJournal of Medicine 1 (2). DOI:10.15347/wjm/2014.010. ISSN 2002-4436. - Own work ([CC BY 3.0](#)) via [Commons Wikimedia](#)
- 2.'Figure 07 04 02' By [CNX OpenStax](#) ([CC BY 4.0](#)) via [Commons Wikimedia](#)

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