

Difference Between NADH and FADH2

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Key Difference – NADH vs FADH2

A [coenzyme](#) is an organic non-protein molecule which is relatively small in size and has the ability to carry chemical groups between [enzymes](#) and act as an electron carrier. NADH (Nicotinamide Adenine Dinucleotide) and FADH2 (Flavin Adenine Dinucleotide) are two main coenzymes utilized in almost all biochemical pathways. They act as electron carriers and participates in [oxidation-reduction](#) reactions of reaction intermediates. **NADH is a derivative of Vitamin B3 (Niacin/Nicotinamide) while FADH2 is a derivative of Vitamin B2 (Riboflavin).** This is the key difference between NADH and FADH2.

What is NADH?

NADH is synthesized from Vitamin B3 (Niacin) and is a coenzyme composed of ribosylnicotinamide 5'-diphosphate coupled to adenosine 5'-phosphate. It serves as an electron carrier in many reactions by alternatively converting to its oxidized ([NAD+](#)) form and the reduced (NADH) form. The reduced NADH acts as an electron donor and oxidize to NAD^+ while reducing the other compound involved in the reaction. This role of NADH is involved in the processes of [glycolysis](#), [TCA cycle](#) and in the electron transport chain where NADH is one of the electron donors.

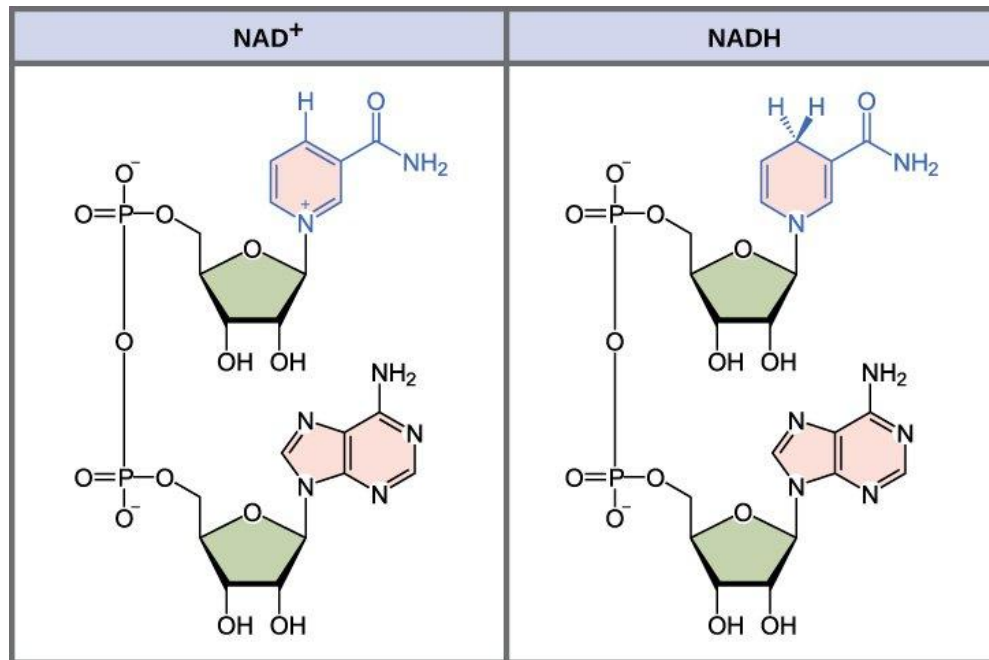


Figure 01: Structures of NADH and NAD⁺

The melting point of NADH is 140.0 – 142.0 °C and it can be synthesized in the body and is not an essential nutrient. But the deficiency of the essential vitamin Niacin can cause a decrease in the composition of NADH in the body. NADH is produced in the [cytosol](#) as well as in the [mitochondria](#). The mitochondrial membrane is impermeable to NADH, and this barrier distinguishes between cytoplasmic and mitochondrial NADH stores.

In commercial applications, NADH is administered orally in order to combat fatigue as well as during energy deprived syndromes and metabolic disorders

What is FADH₂?

FADH₂ is synthesized from the water-soluble vitamin B₂, which is also known as Riboflavin. FADH₂ is the reduced form of flavin adenine dinucleotide (FAD).

FAD is synthesized from riboflavin and two molecules of ATP. Riboflavin is phosphorylated by ATP to produce riboflavin 5'-phosphate (also called flavin mononucleotide, FMN). FAD is then formed from FMN by the transfer of an AMP molecule from [ATP](#). FADH is involved in both carbohydrate [metabolism](#) and fatty acid metabolism. In carbohydrate metabolism, FADH is involved in harvesting high energy electron rich fuels in the TCA cycle. FADH is generated in each round of fatty acid oxidation, and the fatty acyl chain is shortened by two carbon atoms as a result of

these reactions to yield Acetyl Co A. FADH acts as an electron donor in the electron transport.

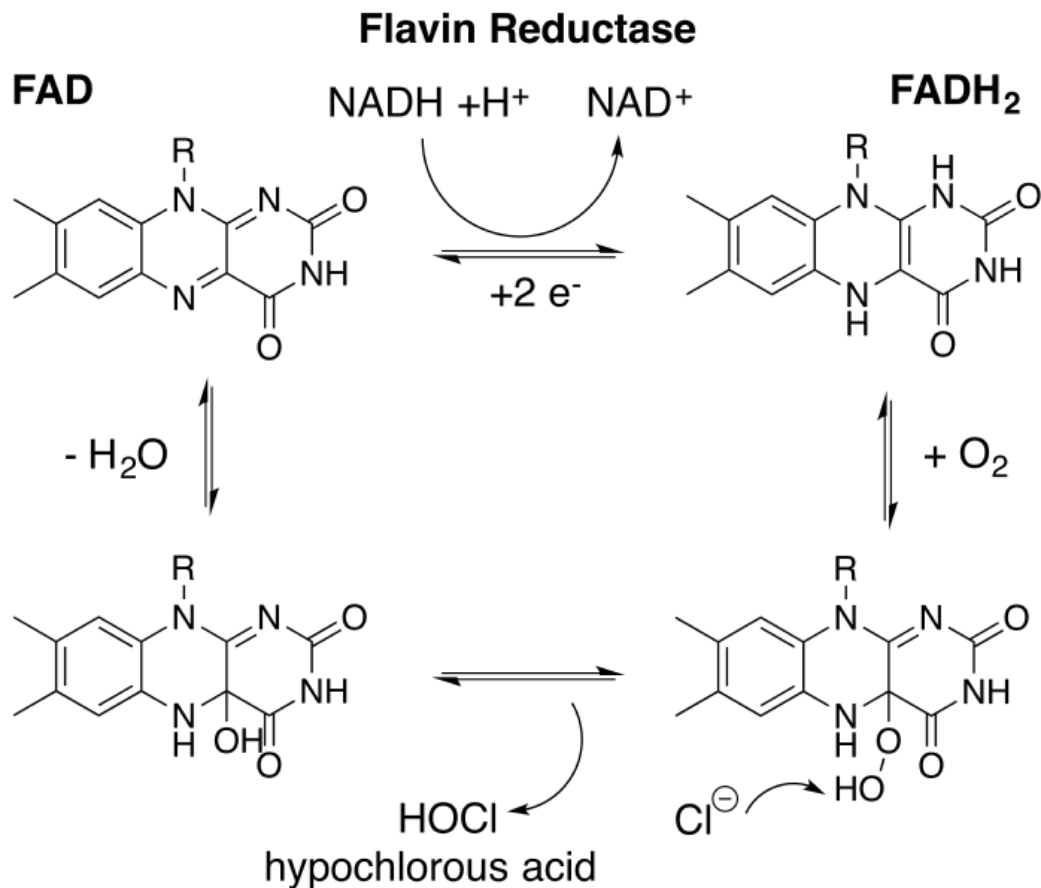


Figure 02: Structures of FAD and FADH

What are the similarities between NADH and FADH2?

- NADH and FADH₂ are coenzymes
- Both act as electron carriers.
- Both are nonprotein organic molecules.
- Both are derived from vitamins.
- Both are water soluble.
- Both can exist in the reduced form or oxidized form.
- Both participate in oxidation and reduction reactions and help in the transfer of electrons from one substrate to the other.
- Both coenzymes can be synthesized in the body.
- Both molecules take part in metabolic pathways which include carbohydrate, fatty acid, amino acid and nucleotide metabolism.

What is the difference between NADH and FADH₂?

NADH vs FADH ₂	
NADH is a coenzyme derived from vitamin B3 or niacin.	FADH ₂ is a coenzyme derived from Vitamin B2 or riboflavin.
ATP Produced	
NADH gives 3 ATP.	NADH gives 2 ATP.
Commercial Applications	
NADH is used as a supplement under energy deprived conditions.	This has no commercial applications.

Summary – NADH vs FADH₂

The role of NADH and FADH₂ is to donate electrons to the electron transport chain and to act as an electron carrier, which carries electrons released from different metabolic pathways to the final process of energy production, i.e., the electron transport chain. They both donate electrons by providing a hydrogen molecule to the oxygen molecule to create water during the electron transport chain. Thus both NADH and FADH₂ are vital in all metabolic processes. The difference between NADH and FADH₂ is that NADH is a coenzyme derived from vitamin B3 or niacin whereas FADH₂ is a coenzyme derived from Vitamin B2 or riboflavin.

References:

1. “FADH₂.” National Center for Biotechnology Information. PubChem Compound Database, U.S. National Library of Medicine, [Available here](#). Accessed 4 Sept. 2017.
2. “Introduction to NAD/NADH.” Introduction to NAD/NADH, [Available here](#). Accessed 4 Sept. 2017.
3. “NADH.” National Center for Biotechnology Information. PubChem Compound Database, U.S. National Library of Medicine, [Available here](#). Accessed 4 Sept. 2017.

Image Courtesy:

1. “Figure 07 01 01ab” By [CNX OpenStax \(CC BY 4.0\)](#) via [Commons Wikimedia](#)
2. “FADH₂ production by flavin reductase for HOCl generation and halogenase activity” By Jmont31 – Diagram made with ChemDraw [\(CC BY-SA 4.0\)](#) via [Commons Wikimedia](#)

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