

Nitrifying Bacteria

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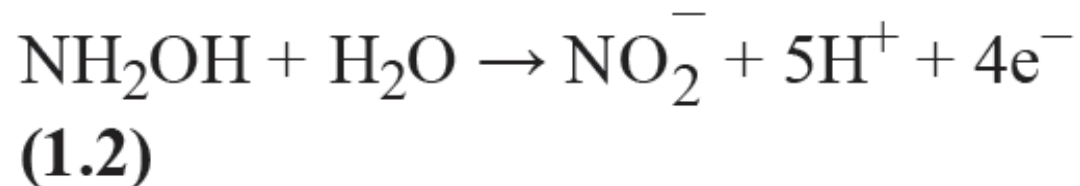
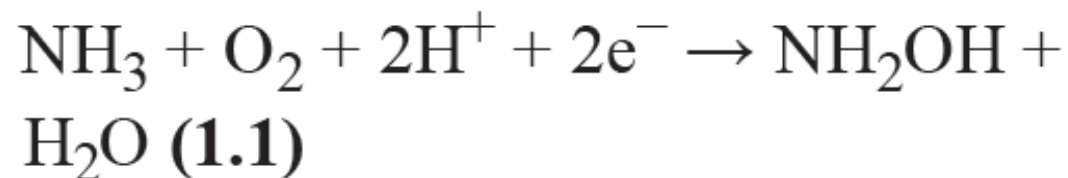
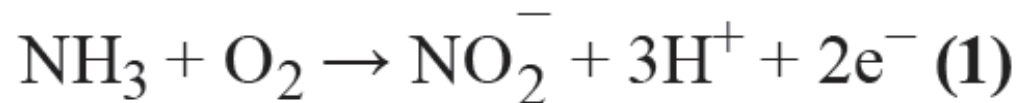
Introduction

- Nitrifying bacteria are chemoautotrophic depending on the genera (*Nitrosomonas*, *Nitrosococcus*, *Nitrobacter*, *Nitrococcus*) bacteria that grow by consuming inorganic nitrogen compounds.
- Many species of nitrifying bacteria have complex internal membrane systems that are the location for key enzymes in nitrification: ammonia monooxygenase which oxidizes ammonia to hydroxylamine, and nitrite oxidoreductase, which oxidizes nitrite to nitrate.

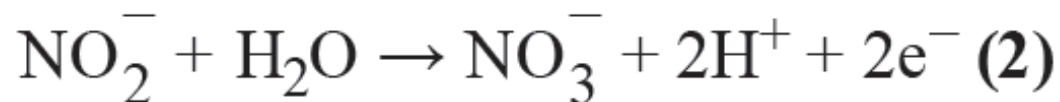
Oxidation of ammonia to nitrate

- Nitrification in nature is a two-step oxidation process of ammonium (NH_4^+ or ammonia NH_3) to nitrate (NO_3^-) catalyzed by two ubiquitous bacterial groups.
- The first reaction is oxidation ammonium to nitrite by ammonium oxidizing bacteria (AOB) represented by *Nitrosomonas* species.
- The second reaction is oxidation nitrite (NO_2^-) to nitrate by nitrite-oxidizing bacteria (NOB), represented by *Nitrobacter* species

Oxidation of
ammonia to
nitrite



Oxidation of
nitrite to
nitrate



Nitrifying bacteria that oxidize ammonia

Genus	Phylogenetic group	DNA (mol% GC)	Habitats	Characteristics
<i>Nitrosomonas</i>	Beta	45-53	Soil, Sewage, freshwater, Marine	Gram-negative short to long rods, motile (polar flagella) or nonmotile; peripheral membrane systems
<i>Nitrosococcus</i>	Gamma	49-50	Freshwater, Marine	Large cocci, motile, vesicular or peripheral membranes
<i>Nitrospira</i>	Beta	54	Soil	Spirals, motile (peritrichous flagella); no obvious membrane system
<i>Nitrosolobus</i>	Beta	54	Soil	Pleomorphic, lobular, compartmented cells; motile (peritrichous flagella)

Nitrifying bacteria that oxidize nitrite

Genus	Phylogenetic group	DNA (mol% GC)	Habitats	Characteristics
<i>Nitrobacter</i>	Alpha	59-62	Soil, Freshwater, Marine	Short rods, reproduce by budding, occasionally motile (single subterminal flagella) or non-motile; membrane system arranged as a polar cap
<i>Nitrospina</i>	Delta	58	Marine	Long, slender rods, nonmotile, no obvious membrane system
<i>Nitrococcus</i>	Gamma	61	Marine	Large Cocci, motile (one or two subterminal flagellum) membrane system randomly arranged in tubes
<i>Nitrospira</i>	Nitrospirae	50	Marine, Soil	Helical to vibroid-shaped cells; nonmotile; no internal membranes

- Nitrosomonas is a genus comprising rod shaped chemoautotrophic bacteria.
- The genus is found in soil, sewage, freshwater, and on building surfaces, especially in polluted areas that contains high levels of nitrogen compounds.
- Nitrosomonas prefers an optimum pH of 6.0-9.0 and a temperature range of 20 to 30°C. Most species are motile with a flagellum located in the polar regions.

Nitrosomonas

Scientific classification

Domain: Bacteria

Phylum: Proteobacteria

Class: Beta Proteobacteria

Order: Nitrosomonadales

Family: Nitrosomonadaceae

Genus: *Nitrosomonas*

Winogradsky, 1892

Species

N. aestuarii

N. communis

N. europaea

N. eutropha

N. halophila

N. marina

N. nitrosa

N. oligotropha

N. ureae

- Nitrobacter is a genus of mostly rod-shaped, gram-negative, and chemoautotrophic bacteria.
- Nitrobacter have an optimum pH between 7.3 and 7.5, and will die in temperatures exceeding 120°F (49°C) or below 32°F (0°C).

Nitrobacter

Scientific classification

Kingdom: Bacteria

Phylum: Proteobacteria

Class: Alpha Proteobacteria

Order: Rhizobiales

Family: Bradyrhizobiaceae

Genus: *Nitrobacter*

Winogradsky 1892

Species

N. alkalicus

N. hamburgensis

N. vulgaris

N. winogradskyi

Thank you