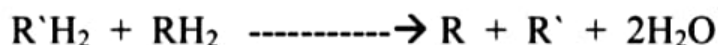


Peroxidative mode: One molecule of H_2O_2 is reduced to water using electrons derived from an organic donor. The overall reaction becomes:



Catalase is the most abundant protein (representing up to 15% of protein content of the organelle), thus every molecule of hydrogen peroxide will be promptly degraded.

2. **Detoxification of toxic compounds**

- In its peroxidative mode catalase can use as its electron donor a variety of substances including methanol, ethanol, formic acid, formaldehyde, nitrites and phenols. Since, all these compounds are harmful to the cells; their detoxification by catalase is of vital importance.
- Prominent peroxisomes of liver and kidney are thought to be important in such detoxification reactions.

3. **Fatty acid oxidation:**

- Oxidation of fatty acids, in many animal cells, occurs in both peroxisomes and mitochondria, but in yeasts and plants, only limited to peroxisomes.
- Oxidation is accompanied by the production of H_2O_2 which is decomposed by **catalase** enzyme. This provides a major source of metabolic energy.
- Peroxisomes in many animals' cells have enzymes necessary to oxidize fatty acid. This process called Beta-oxidation also occurs in mitochondria.
- About 25-50% fatty acid oxidation in animal tissues occur in peroxisomes and the rest in mitochondria.
- Peroxisomal Beta-oxidation is especially important in the catabolism of fatty acids with especially long carbon chains.

3. **Lipid biosynthesis**

- Synthesis of cholesterol and dolichol occurs in both ER and peroxisomes. Bile acid synthesis takes place from cholesterol in the liver.
- Peroxisomes contain enzymes to synthesize plasmalogens, a family of phospholipids which are important membrane components of tissues of the heart and brain.

4. **Photorespiration**

- Peroxisomes in leaves particularly in the green ones carry out the photorespiration process along with chloroplasts.
- This spatial proximity reflects the mutual involvement of these three organelles in photorespiration, a light dependent process that occurs only in photosynthetic tissue.

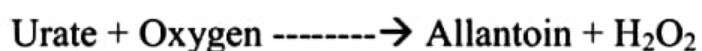
- Photorespiration involves the uptake of oxygen and release of carbon dioxide thereby decreasing the net amount of carbon converted into organic form by photosynthetic tissue. Several of the key enzymes of photorespiration are localized to leaf peroxisomes.

5. **Degradation of purines**

- Carry out the catabolism of purines, polyamines and amino acids especially by uric acid oxidase.

6. **Metabolism of nitrogen containing compounds**

- Peroxisomes of most animals except primates contain an enzyme called urate oxidase (also called uricase) needed to oxidize urate, a purine formed during the catabolism of nucleic acids and some proteins.



For this oxygen is required and hydrogen peroxide is formed (metabolized by catalase) and allantoin is further metabolized and excreted as allantoinic acid.

- Other peroxisomal enzymes like aminotransferases (which catalyze the transfer of amino acids to alpha-keto acids) help in the synthesis and degradation of amino acids by moving amino group from one molecule from another.

7. **Breakdown of unusual substances**

- Some of the substances for peroxisomal oxidases are rare compounds for which the cell has no other degradative pathways such as D-Amino acids which are not recognized by enzymes which degrade L-Amino acids.
- Some fungi are capable of metabolizing alkenes, short term hydrocarbon compounds found in oil and other petroleum products.
- These fungi may be useful for cleaning up oil spills that would otherwise contaminate the environments.

8. **Bioluminescence**

- Luciferase enzyme found in the peroxisomes of fireflies help in bioluminescence and thus aids the flies in finding a mate or its meal.

9. **Germination of seeds**

- Peroxisomes in seeds responsible for the conversion of stored fatty acids to carbohydrates, critical to providing energy and raw materials for the growth of germinating plants.
- Distinct type of plant peroxisomes occurs transiently in seedlings of plant species that store carbon and energy reserves in the seeds as fats, mainly triglycerides.

- In these species, stored triglycerides are metabolized and converted to sucrose during post germinative development by a sequence of events which included Beta-oxidation of fatty acids as well as glycosylate cycle.
- All the enzymes needed for these processes are localized to specialized peroxisomes called ***Glyoxysomes***.
- Glyoxysomes are found only in tissues in which fat is stored I cotyledons or endosperm. They are present for a relatively short period of time (a week) required for the seedling to deplete its supply of stored fats.
- Glyoxysomes have been reported to appear again in senescent tissues of some plant species to degrade lipids derived from the membranes of senescent cells.

Biogenesis of Peroxisomes

- Like any other organelle, peroxisomes biogenesis occurs by the division of preexisting peroxisomes.
- Proteins destined for peroxisomes are synthesized not on membrane bound ribosomes (RER) but on the ribosomes of the cytosol and then enter pre-existing peroxisomes as full length polypeptides.
- A process mediated by specific membrane proteins. This mode of protein import is known as ***Post translational protein import***.

Key points

- Lipid metabolism and chemical detoxification are important functions of peroxisomes.
- Responsible for oxidation reactions that break down fatty acids and amino acids.
- Peroxisomes oversee reactions that neutralize free radicals, which cause cellular damage and cell death.
- Peroxisomes chemically neutralize poisons through a process that produces large amounts of toxic H_2O_2 , which is then converted into water and oxygen.
- The liver is the organ primarily responsible for detoxifying the blood before it travels throughout the body; as a result, liver cell contain large amounts of peroxisomes.

Differentiate between Lysosomes and Peroxisomes

Lysosomes

- Membrane bound sacs performing a **digestive** function
- Contains enzymes to digest food, wastes, invading bacteria and breaks down old organelles
- Present in animal cells only
- Golgi apparatus produces lysosomes
- Tay – Sachs disease

Peroxisomes

- Membrane bound sacs performing a digestive function
- Enzymes in peroxisomes are *oxidases* that catalyze redox reactions
- Liver contains many peroxisomes to break down alcohol
- Form by budding off from ER
- Present in animal cells only