



COMPILED AND CIRCULATED BY DR. POULAMI ADHIKARY MUKHERJEE, ASSISTANT
PROFESSOR, DEPARTMENT OF ZOOLOGY, NARAJOLE RAJ COLLEGE

DEAMINATION

BY

DR. POULAMI ADHIKARY MUKHERJEE
ASSISTANT PROFESSOR
DEPARTMENT OF ZOOLOGY
NARAJOLE RAJ COLLEGE

ZOOLOGY: SEM- III, PAPER- C7T: FUNDAMENTALS OF BIOCHEMISTRY, UNIT 3: PROTEINS



COMPILED AND CIRCULATED BY DR. POULAMI ADHIKARY MUKHERJEE, ASSISTANT PROFESSOR, DEPARTMENT OF ZOOLOGY, NARAJOLE RAJ COLLEGE

Deamination is the removal of an amino group from a molecule. Enzymes that catalyse this reaction are called deaminases.

- **In the human body, deamination takes place primarily in the liver, however it can also occur in the kidney.**
- **In situations of excess protein intake, deamination is used to break down amino acids for energy.**



COMPILED AND CIRCULATED BY DR. POULAMI ADHIKARY MUKHERJEE, ASSISTANT PROFESSOR, DEPARTMENT OF ZOOLOGY, NARAJOLE RAJ COLLEGE

- **The amino group is removed from the amino acid and converted to ammonia.**
- **The rest of the amino acid is made up of mostly carbon and hydrogen, and is recycled or oxidized for energy.**
- **Ammonia is toxic to the human system, and enzymes convert it to urea or uric acid by addition of carbon**



COMPILED AND CIRCULATED BY DR. POULAMI ADHIKARY MUKHERJEE, ASSISTANT PROFESSOR, DEPARTMENT OF ZOOLOGY, NARAJOLE RAJ COLLEGE

dioxide molecules (which is not considered a deamination process) in the urea cycle, which also takes place in the liver.

- **Urea and uric acid can safely diffuse into the blood and then be excreted in urine.**

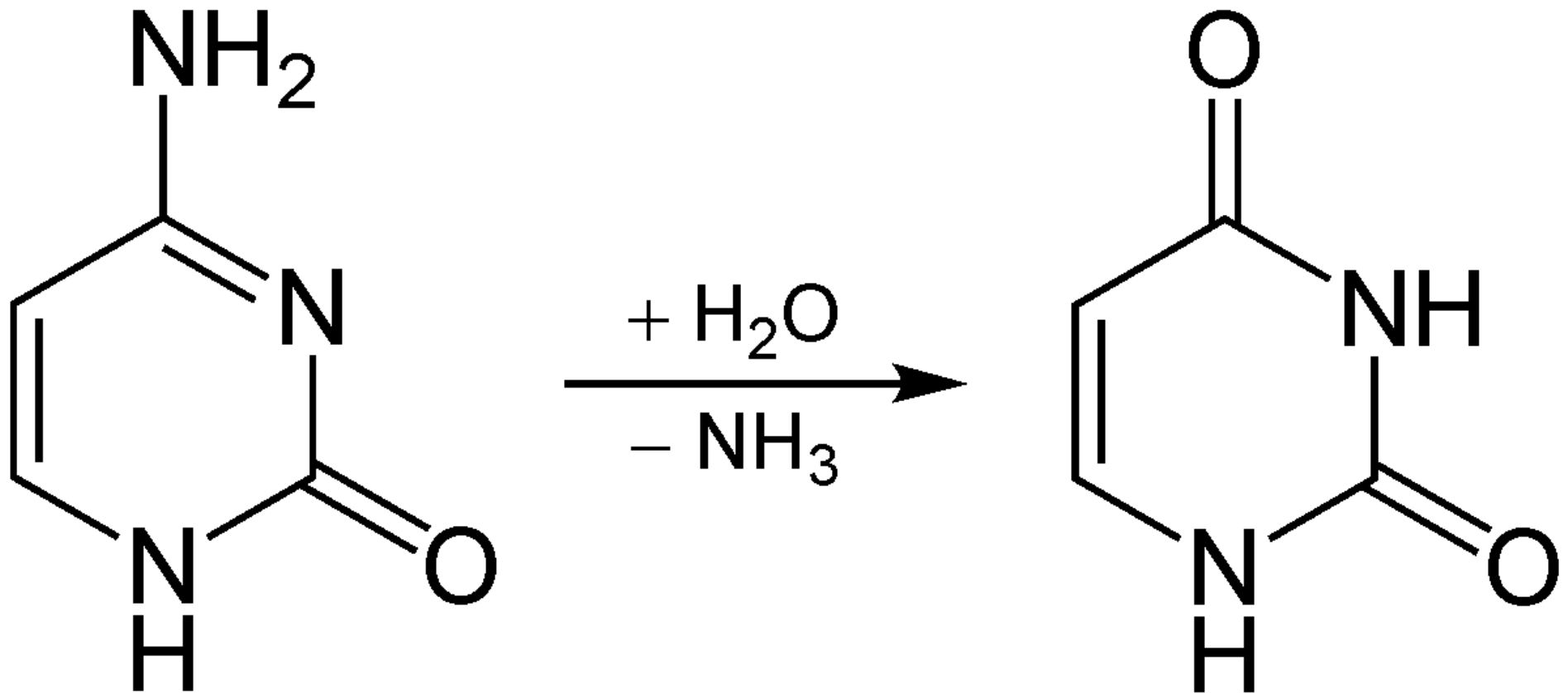


COMPILED AND CIRCULATED BY DR. POULAMI ADHIKARY MUKHERJEE, ASSISTANT PROFESSOR, DEPARTMENT OF ZOOLOGY, NARAJOLE RAJ COLLEGE

Deamination reactions in DNA:

Cytosine:

Spontaneous deamination is the hydrolysis reaction of cytosine into uracil, releasing ammonia in the process. This can occur in vitro through the use of bisulfite, which deaminates cytosine, but not 5-methylcytosine. This property can be used to sequence methylated DNA to distinguish non-methylated cytosine and methylated cytosine.



Deamination of cytosine to uracil



COMPILED AND CIRCULATED BY DR. POULAMI ADHIKARY MUKHERJEE, ASSISTANT PROFESSOR, DEPARTMENT OF ZOOLOGY, NARAJOLE RAJ COLLEGE

In DNA, this spontaneous deamination is corrected for by the removal of uracil by uracil-DNA glycosylase, generating an abasic (AP) site. The resulting abasic site is then recognised by enzymes (AP endonucleases) that break a phosphodiester bond in the DNA, permitting the repair of the resulting lesion by replacement with another cytosine. A DNA polymerase may perform this replacement via nick translation, a terminal excision reaction by its 5'→3' exonuclease activity, followed by a fill-in reaction by its



COMPILED AND CIRCULATED BY DR. POULAMI ADHIKARY MUKHERJEE, ASSISTANT PROFESSOR, DEPARTMENT OF ZOOLOGY, NARAJOLE RAJ COLLEGE

polymerase activity. DNA ligase then forms a phosphodiester bond to seal the resulting nicked duplex product, which now includes a new, correct cytosine (Base excision repair).

5-methylcytosine:

Spontaneous deamination of 5-methylcytosine results in thymine and ammonia. This is the most common single nucleotide mutation. In DNA, this reaction, if detected



COMPILED AND CIRCULATED BY DR. POULAMI ADHIKARY MUKHERJEE, ASSISTANT PROFESSOR, DEPARTMENT OF ZOOLOGY, NARAJOLE RAJ COLLEGE

prior to passage of the replication fork, can be corrected by the enzyme thymine-DNA glycosylase, which removes the thymine base in a G/T mismatch. This leaves an abasic site that is repaired by AP endonucleases and polymerase, as with uracil-DNA glycosylase.



COMPILED AND CIRCULATED BY DR. POULAMI ADHIKARY MUKHERJEE, ASSISTANT PROFESSOR, DEPARTMENT OF ZOOLOGY, NARAJOLE RAJ COLLEGE

Guanine:

Deamination of guanine results in the formation of xanthine. Xanthine, in a manner analogous to the enol tautomer of guanine, however, it still pairs with cytosine.

Adenine:

Deamination of adenine results in the formation of hypoxanthine. Hypoxanthine, in a manner analogous to the imine tautomer of adenine, selectively base pairs with



COMPILED AND CIRCULATED BY DR. POULAMI ADHIKARY MUKHERJEE, ASSISTANT
PROFESSOR, DEPARTMENT OF ZOOLOGY, NARAJOLE RAJ COLLEGE

cytosine instead of thymine. This results in a post-replicative transition mutation, where the original A-T base pair transforms into a G-C base pair.



COMPILED AND CIRCULATED BY DR. POULAMI ADHIKARY MUKHERJEE, ASSISTANT PROFESSOR, DEPARTMENT OF ZOOLOGY, NARAJOLE RAJ COLLEGE

Oxidative deamination:

Oxidative deamination is a form of deamination that generates α -keto acids and other oxidized products from amine-containing compounds, and occurs only in the liver.

Oxidative deamination is an important step in the catabolism of amino acids, generating a more metabolizable form of the amino acid, and also generating ammonia as a toxic byproduct. The ammonia generated in



COMPILED AND CIRCULATED BY DR. POULAMI ADHIKARY MUKHERJEE, ASSISTANT PROFESSOR, DEPARTMENT OF ZOOLOGY, NARAJOLE RAJ COLLEGE

this process can then be neutralized into urea via the urea cycle.

Much of the oxidative deamination occurring in cells involves the amino acid glutamate, which can be oxidatively deaminated by the enzyme glutamate dehydrogenase (GDH), using NAD or NADP as a coenzyme. This reaction generates α -ketoglutarate (α -KG) and ammonia. Glutamate can then be regenerated from α -KG



COMPILED AND CIRCULATED BY DR. POULAMI ADHIKARY MUKHERJEE, ASSISTANT PROFESSOR, DEPARTMENT OF ZOOLOGY, NARAJOLE RAJ COLLEGE

via the action of transaminases or aminotransferase, which catalyze the transfer of an amino group from an amino acid to an α -keto acid. In this manner, an amino acid can transfer its amine group to glutamate, after which GDH can then liberate ammonia via oxidative deamination. This is a common pathway during amino acid catabolism.



COMPILED AND CIRCULATED BY DR. POULAMI ADHIKARY MUKHERJEE, ASSISTANT PROFESSOR, DEPARTMENT OF ZOOLOGY, NARAJOLE RAJ COLLEGE

Another enzyme responsible for oxidative deamination is monoamine oxidase, which catalyzes the deamination of monoamines via addition of oxygen. This generates the corresponding ketone- or aldehyde-containing form of the molecule, and generates ammonia. Monoamine oxidases MAO-A and MAO-B play vital roles in the degradation and inactivation of monoamine neurotransmitters such as serotonin and epinephrine. Monoamine oxidases are



COMPILED AND CIRCULATED BY DR. POULAMI ADHIKARY MUKHERJEE, ASSISTANT
PROFESSOR, DEPARTMENT OF ZOOLOGY, NARAJOLE RAJ COLLEGE

**important drug targets, targeted by MAO inhibitors
(MAOIs) such as selegiline.**



**COMPILED AND CIRCULATED BY DR. POULAMI ADHIKARY MUKHERJEE, ASSISTANT
PROFESSOR, DEPARTMENT OF ZOOLOGY, NARAJOLE RAJ COLLEGE**

THANK YOU

ZOOLOGY: SEM- III, PAPER- C7T: FUNDAMENTALS OF BIOCHEMISTRY, UNIT 3: PROTEINS