Organic Chemistry of Amines.

Amines:

Amines are a group of organic compounds that are derived from ammonia (NH_3) Figure (1), compounds that has a nitrogen atom connected with two hydrogen atoms ($-NH_2$), and a single group of some other atoms for example (R), are amines.

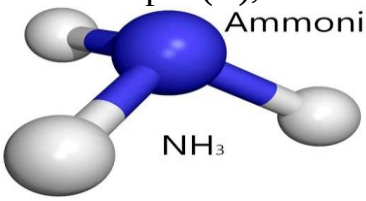

Figure 1: Ammonia

Amines are extremely important functional groups in medicinal chemistry and are present in many drugs. Amines are present in amino acids of proteins, purine and pyrimidine of DNA .The nitrogen atom has one ion pair of electrons and can act as a hydrogen bond acceptor for one hydrogen bond.

Classification of Amines:

Amines are classified by the number of organic compounds attached with the central nitrogen atom

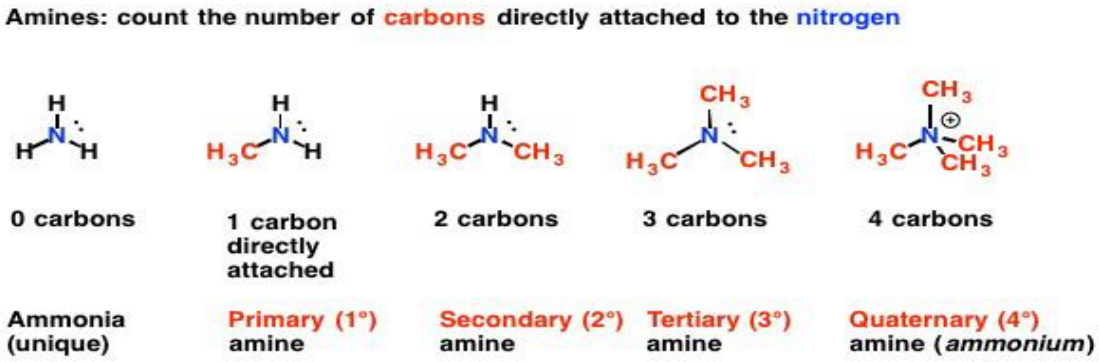

Figure2: classification of Amines

1- Primary amines compounds **(RNH_2)** are water soluble, have one carbon atom attach to NH_2 group & R" is an alkyl group.
2- Secondary amines compounds **(R_2NH)** have N–H group, and two alkyl group R have been replaced in an ammonia molecule.
3-Tertiary amines compounds **(R_3N)** haven't N–H group (water insoluble).
4- Quaternary amines compounds **(NR_4^+)** are positively charged polyatomic ions of the structure NR_4^+ with R being alkyl or aryl groups.

Amine Properties

- The lower aliphatic amines with a fishy smell are gaseous in nature.
- Primary amines are liquids at room temperature containing three to four carbon atoms, whereas higher amines are solids.
- Aniline and other arylamines are normally colourless, but when stored open due to atmospheric oxidation, they get painted.
- Lower aliphatic amines can form water molecular hydrogen bonds, making them water-soluble.
- Increasing the size of the hydrophobic alkyl portion decreases the amine molar weight, resulting in a decrease in water solubility.
- Lower amines in the soil are insoluble. Organic solvents such as ethanol, benzene, and ether dissolve amines readily.
- As a product of hydrogen bonding between the nitrogen and the hydrogen of the other atom, primary and secondary amines are often involved in the intermolecular interaction.
- Due to the availability of two hydrogen atoms, the intermolecular association is more prominent in primary amines compared to secondary. Due to the absence of a free hydrogen atom for bonding, there is no intermolecular association in tertiary amines

Source of Amines

More than **20 heterocyclic aromatic amines** have been reported in cooked meat and fish
Biogenic amine : is a biogenic substance with one or more amine groups. They are basic nitrogenous compounds formed mainly by decarboxylation of amino acids or by amination and transamination of aldehydes and ketones. Biogenic amines are organic bases with low molecular weight and are synthesized by microbial, vegetable and animal metabolisms
They play an important role as source of nitrogen and precursor for the synthesis of hormones, alkaloids, nucleic acids, proteins, amines and food aroma components. However, food containing high amounts of biogenic amines
In humans, biogenic amines are involved in brain activity regulate brain functions such as movement, behavior, emotions, temperature, blood pressure and endocrine secretion and regulation of stomach pH.

Biological activity

Amines are ubiquitous in biology. The breakdown of amino acids releases amines, famously in the case of decaying fish which smell of trimethylamine. Many neurotransmitters are amines, including epinephrine, norepinephrine, dopamine, serotonin, and histamine. Protonated amino groups ($-NH^{+}_{3}$) are the most common positively charged moieties in proteins, specifically in the amino acid lysine. The anionic polymer DNA is typically bound to various amine-rich proteins. Additionally, the terminal charged primary

ammonium on lysine forms salt bridges with carboxylate groups of other amino acids in polypeptides, which is one of the primary influences on the three-dimensional structures of proteins.

Uses of Amines

Some of the uses of Amines include;

- Manufacture of azo dyes.
- Used in drugs mainly to interfere with the action of natural amine neurotransmitters.
- In gas treatment mainly in the removal of carbon dioxide from natural gas, etc.
- As corrosion inhibitors.
- In the synthesis of many products.
- Neurotransmitters such as acetylcholine, catecholamine's and serotonin .
- Others are amine hormones
- Components of phospholipids , bacteria or ribosomes.
- Enter endocrine cells , distributed widely in the gastric , intestinal and pancreatic tissue, synthesize peptide and amine hormones that control the secretion of digestive juices.

Health effects of amines and their derivatives

Many higher molecular weight amines are highly active biologically . Naturally , vital amines are amino acids which the human body utilize to produce proteins that are very important in the biochemistry of the human body system .Low molecular weight amines are poisonous, where few are simply absorbed through the skin .Amines themselves might not be harmful but they could react with compounds to form nitroaoamines and nitramines which affect the environmental and humans and animals .Several of the amino compounds are also known to be carcinogenic , Nitrosodimethylamine (NDMA) it’s a carcinogen . In some of the industries there has been a continuous rise in bladder infection which is due to the aromatic amines.

Metabolic breakdown of proteins in all mammals

Urea is the chief nitrogenous end product of the metabolic breakdown of proteins in all mammals and some fishes .Its formula is H2NCONH2.in the breakdown of proteins m amino group are removed from the amino acids that partly comprise proteins. These amino groups are converted to ammonia , which is toxic to the body and thus must be converted to urea by the liver . The urea then passes to the kidney and is eventually excreted in the urine.

Note//

Amines and amides are two types of compounds found in the field of organic chemistry. Although both types are composed of nitrogen atoms along with other atoms, there are distinct characteristics and properties present in amines and amides. The main difference between amine and amide is the presence of a carbonyl group in their structure; **amines have no carbonyl groups attached to the nitrogen atom whereas amides have a carbonyl group attached to a nitrogen atom.**

Amines are derivatives of ammonia with at least one alkyl or aryl group, while Amides are derivatives of a carboxylic acid with a carbonyl group attached to a nitrogen atom.