NICOTINE

M.Sc (SEM IV)
Elective Course 1c
Organic Chemistry Special

Dr. Amrita Prasad
Assist. Prof. Chemistry
Magadh Mahila College

Contents

- Nicotine introduction
- Structure determination
- Synthesis of Nicotine

NICOTINE

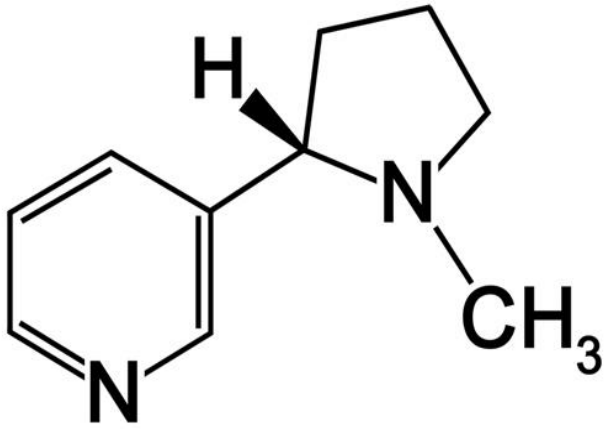
•Nicotine is the chief alkaloid of tobacco plant.

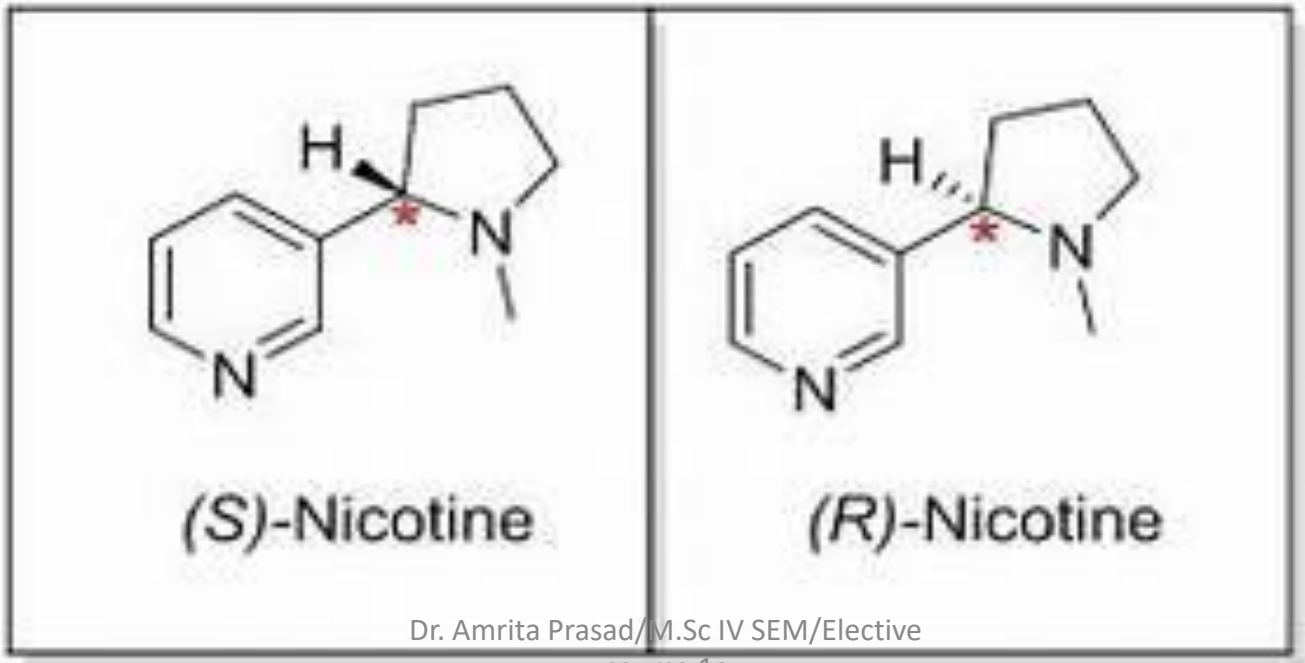
•IUPAC name 3-(1-methyl-2-pyrrolidinyl) pyridine.

•It is a bicyclic compound with a pyridine cycle and a pyrrolidine cycle. The molecule possess an asymmetric carbon and so exists in two enantiomeric compounds.

• It occurs in the plant leaves as salts of malic acid and citric acid to the extent of 4 to 5 percent. The alkaloid was named after the Frenchman NICOT who introduced tobacco in France in 1560.

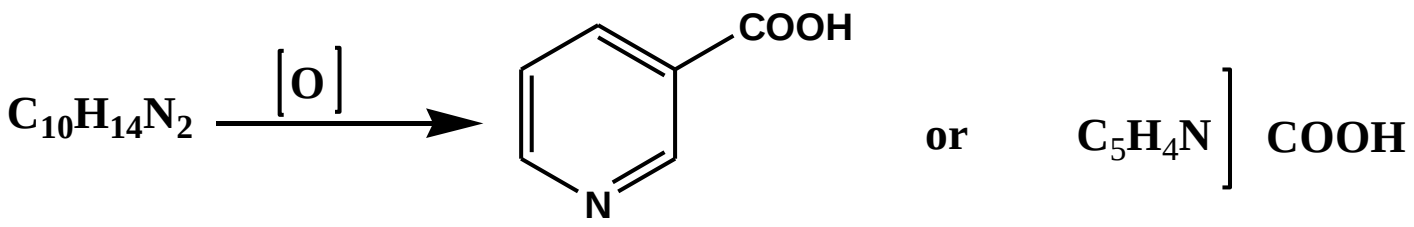
Structure of Nicotine





Structure Determination

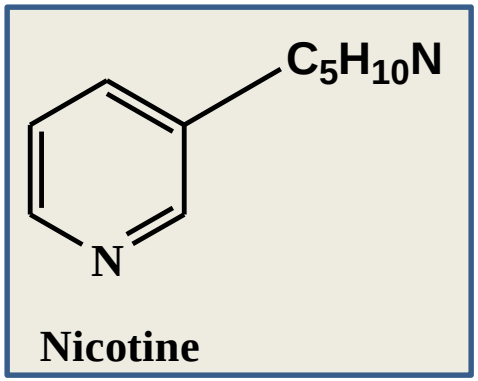
1. Elemental analysis and molecular weight determination leads to the molecular formula $C_{10}H_{14}N_2$ for nicotine.
2. It absorbs two molecules of CH_3I, suggesting the tertiary nature of both the nitrogen atoms.
3. On oxidation with chromic acid, nicotine yields nicotinic acid (pyridine-3-carboxylic acid).



This shows that the alkaloid contains a pyridine nucleus with a side chain at the 3 position. That is the side chain has the

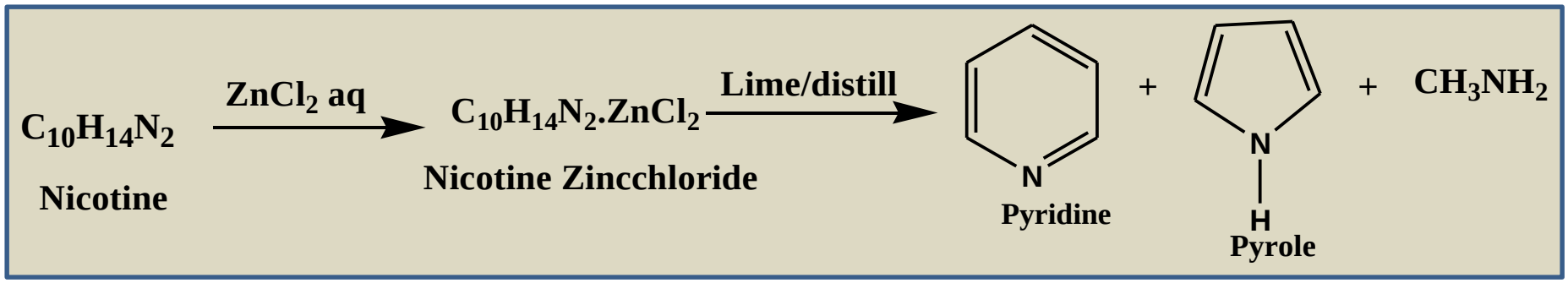
composition($C_{10}H_{14}N_2$=C_5H_4N-$C_5H_{10}N$).

Therefore the formula for nicotine may be written as:

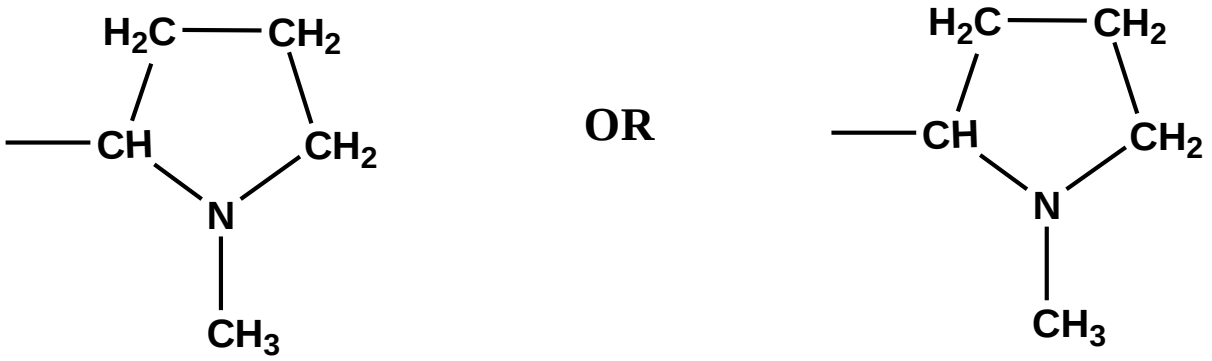


4. Nature and position of the side chain-

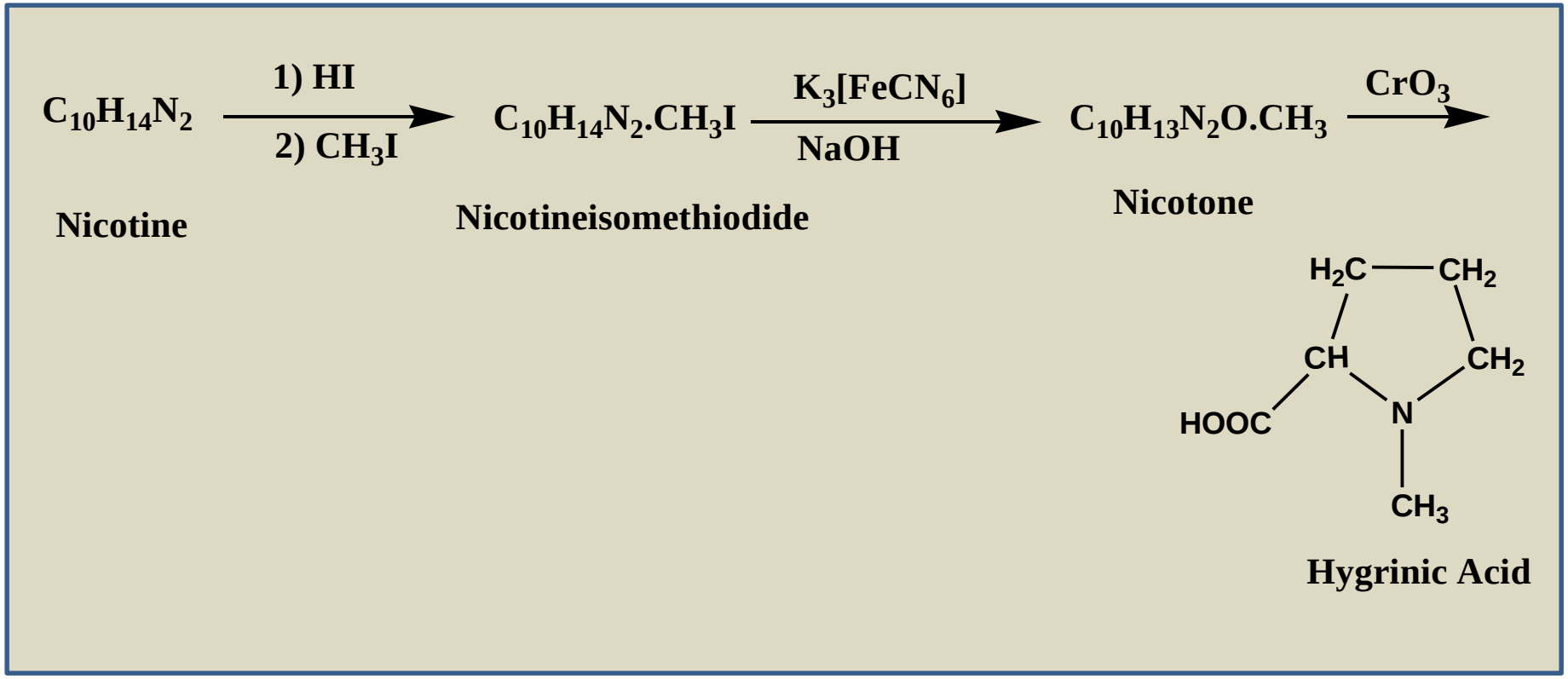
a)The alkaloid forms an addition compound with zinc chloride, $C_{10}H_{14}N_2.ZnCl_2$,which when heated with lime yields pyridine, pyrole, and methylamine.



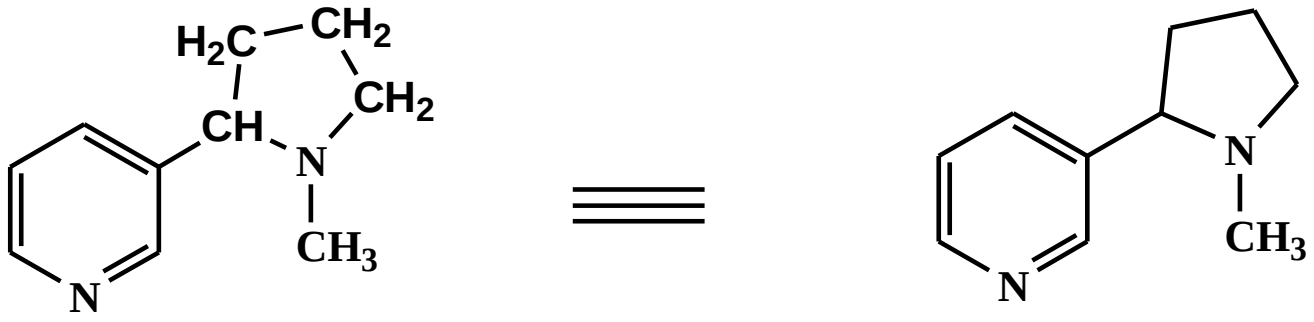
b)When heated with concentrated hydriodic acid at 200-300^{o}c, nicotine yields CH_3I, showing that methyl group is attached to N atom.Therefore,it appears that the side chain could be N- methylpyrrolidine.



c) Nicotine hydriodide when treated with CH_3I, forms nicotine isomethiodide which on oxidation with potassium ferricyanide yields nicotone. This on further oxidation with chromium trioxide produces hygrinic acid.

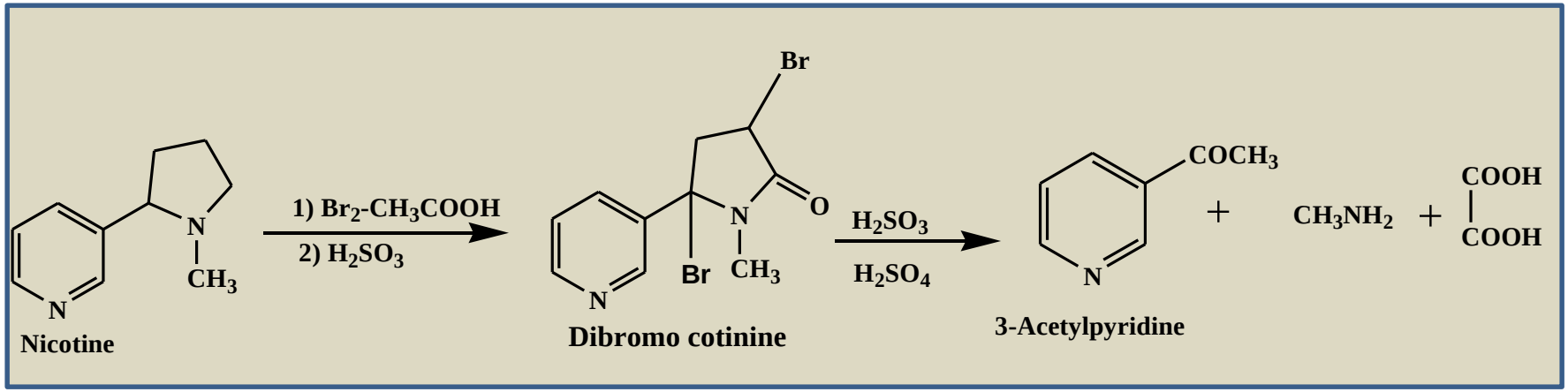


5. From the foregoing considerations the structural formula of nicotine may be written as:

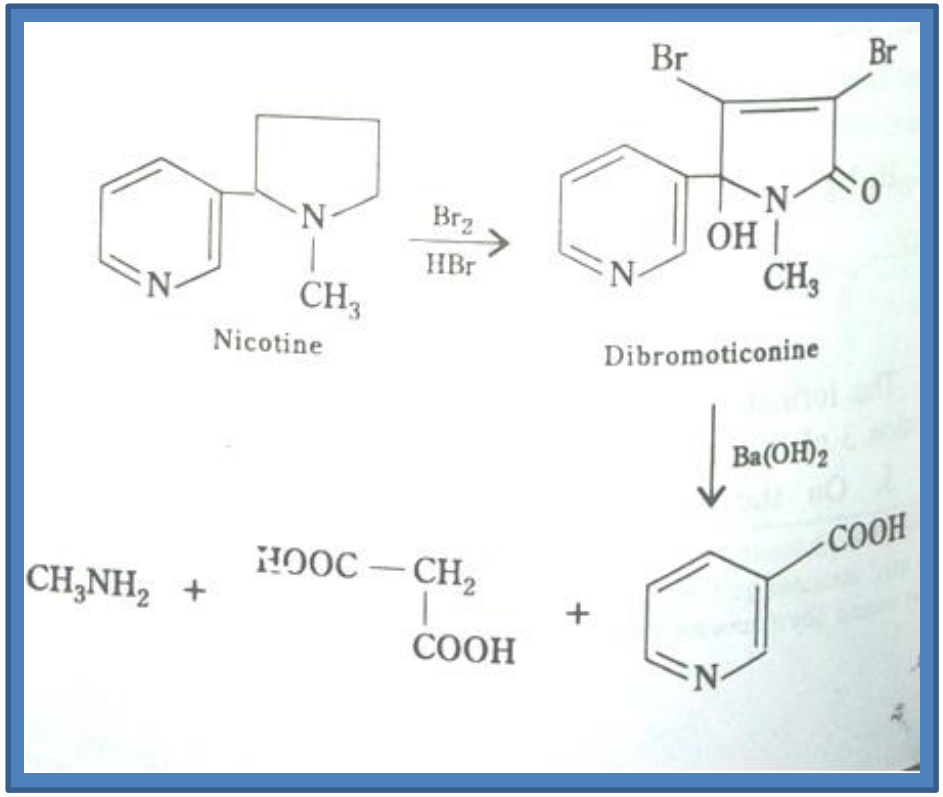


6. The above structure of nicotine is further confirmed as it explains the following reactions:

a) Nicotine when treated with bromine in acetic acid followed by aqueous sulphurous acid gives dibromocotinine,$C_{10}H_{10}ON_2Br_2$.This upon oxidation with a mixture of sulphurous acid and sulphuric acid at 130-140 ^oc, yields 3-acetylpyridine,oxalic acid and methylamine.



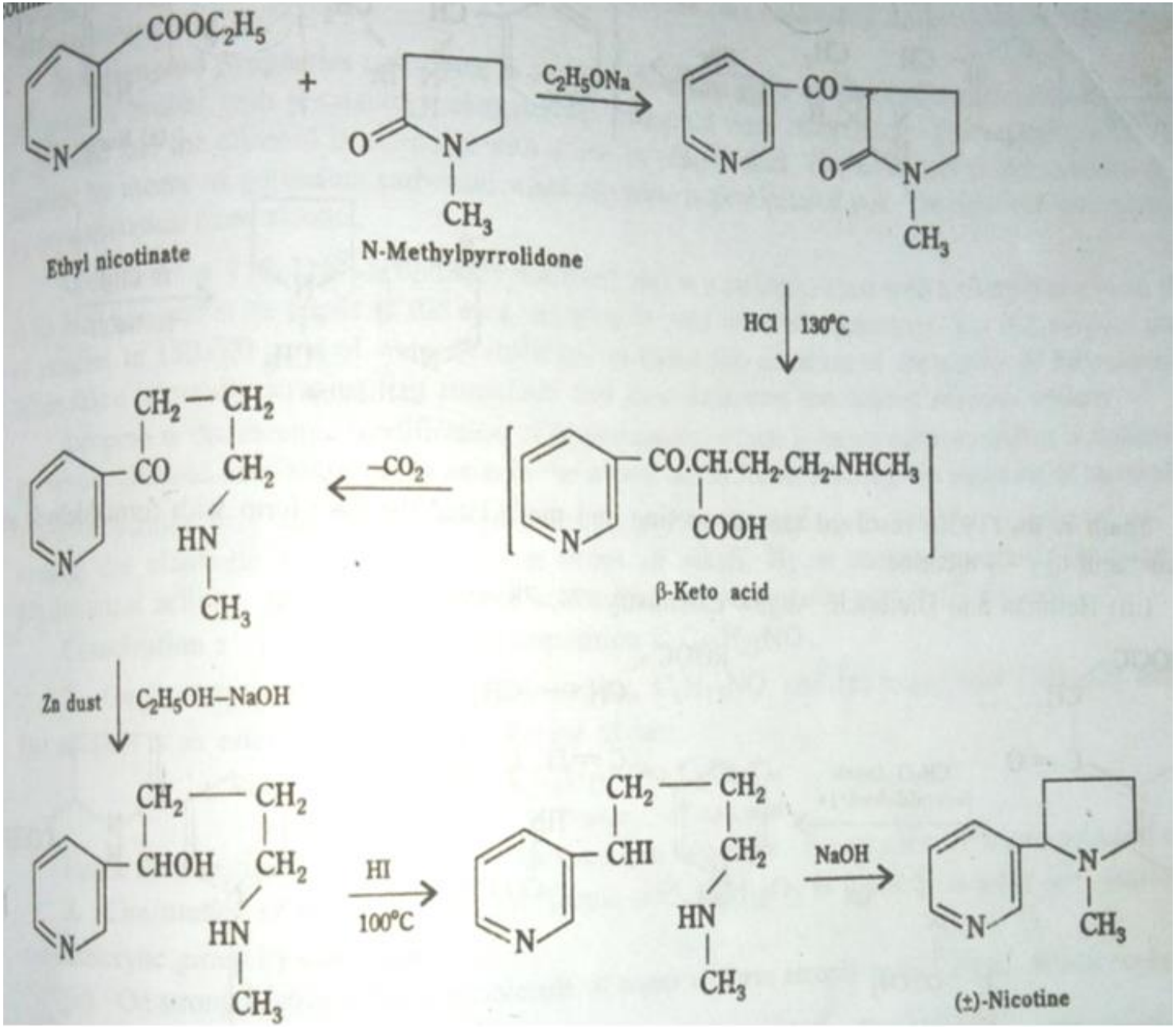
b) Nicotine on reaction with bromine in hydrobromic acid gives dibromoticonine which when heated with barium hydroxide solution at 100°c,yields nicotinic acid,malonic acid and methylamine.



SYNTHESIS

- Finally the structure of nicotine was confirmed by the following synthesis accomplished by Spath(1928).This synthesis also confirms pinners formula for nicotine. (scheme given in the next slide)

- The racemic alkaloid obtained is resolved by means of (+)-tartaric acid to get (-)-nicotine which is found to be identical with the natural alkaloid.



Synthesis of Nicotine

Books Recommended

1. Bahl and Bahl ; Advance organic Chemistry
2. OP Agrawal; Natural Products, Organic Chemistry Volume 1

THANK YOU