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Chemistry

SUB. CODE- BSCC2402

For B.Sc. 4th Semester

(Alkaloids)
Module-VI

Nicotine

By

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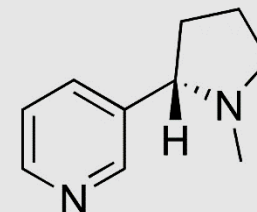
Nicotine: Occurrence

Nicotine, or N-Methyl-2-b-pyridylpyrrolidine has the molecular formula $C_{10}H_{14}N_2$.

Nicotine is a natural product of tobacco, **occurring** in the leaves of *Nicotiana tabacum* in a range of 0.5 to 7.5% depending on variety. **Nicotine** is also found in the leaves of *Nicotiana rustica*, in amounts of 2–14%. Natural form is (-) – form with sp. rotation value -169°



Tobacco leaves



Nicotine

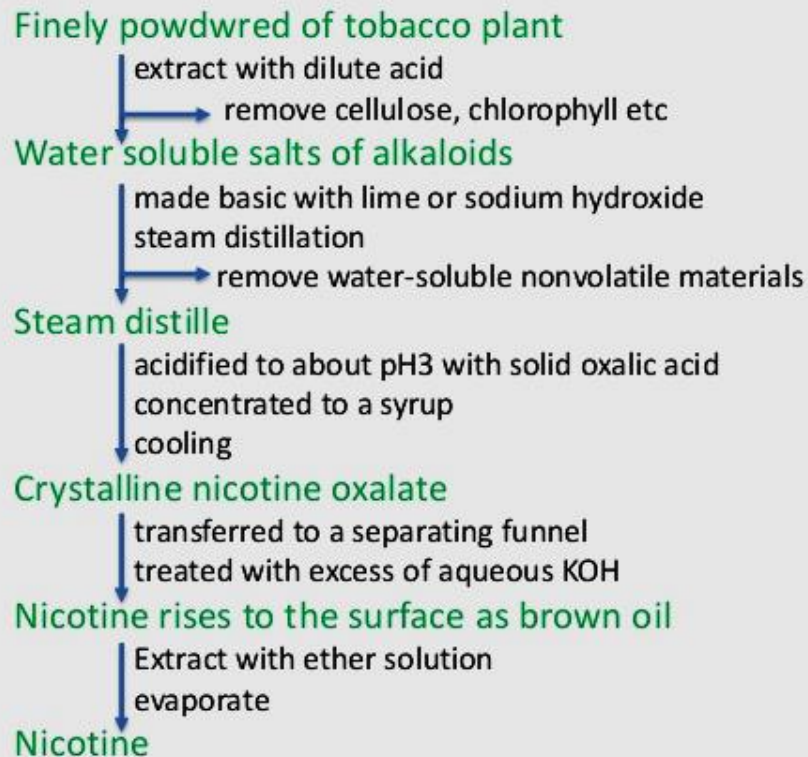


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Isolation

The powdered leaves are extracted with water and alkali is added. The liberated alkaloid is steam distilled to give crude nicotine which is purified by fractional crystallization.

Isolation of Nicotine





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Properties

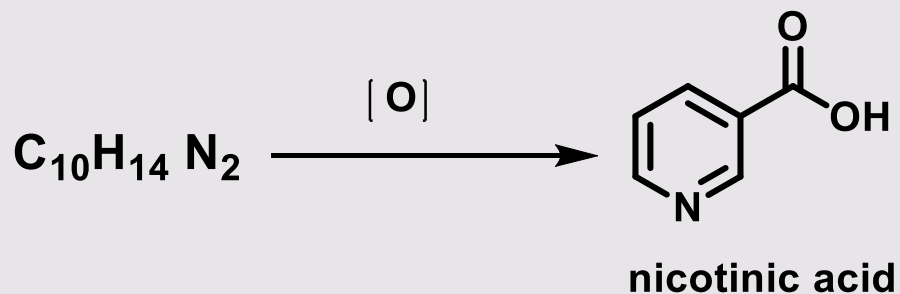
1. It exists in a liquid form.
2. It is colourless.
3. The boiling point is 246°C
4. It has a tobacco like smell.
5. It is soluble in water and also in organic solvents such as ethanol, ether and benzene.
6. It is a deadly poison to animals.
7. In small quantities, nicotine stimulate the nervous system for a while. A low nicotine content tobacco is used for smoking purposes.



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STRUCTURE ELUCIDATION

- Mol formula was determined as $C_{10}H_{14}N_2$
- It is a ditertiary base. It forms dimethiodide but no acetylation occurs
- From Herzig-Meyer reaction, it is found that it contains one $-NCH_3$.
- On oxidation with $KMnO_4$ or Chromic acid, nicotinic acid is formed.



It shows that nicotine is a pyridine derivative with a side chain at 3- position.

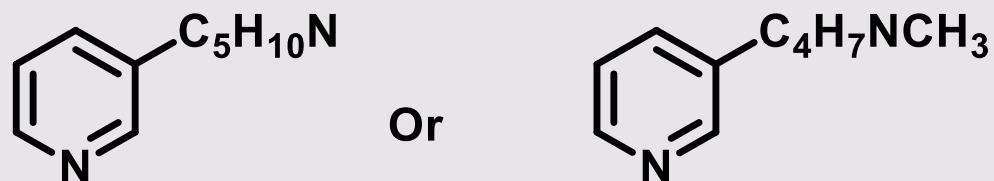


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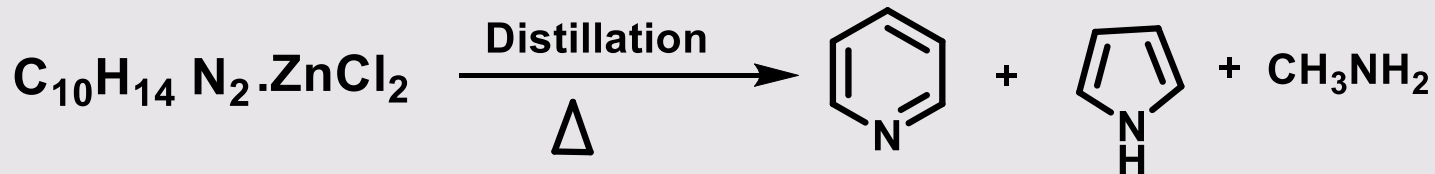
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STRUCTURE ELUCIDATION

- The side chain contains a $-\text{NCH}_3$ group. The formula now can be written as



- Upon distillation, nicotine- ZnCl_2 complex gives, pyridine, pyrrole and methylamine.



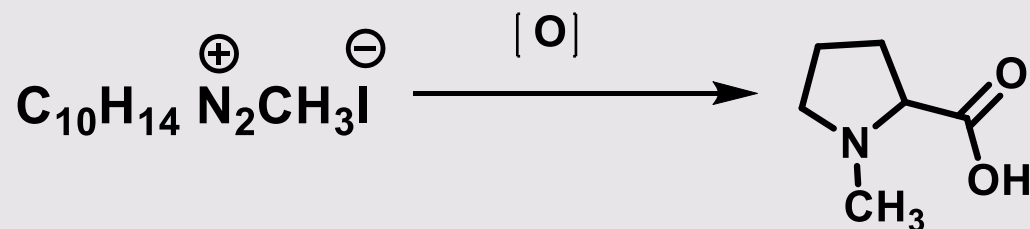


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STRUCTURE ELUCIDATION

- Upon oxidation, nicotine methiodide gives hygrinic acid.



N-methyl-pyrrolidine-2-carboxylic acid

Hygrinic acid

- This suggests that 2-position of N-methylpyrrolidine ring is attached to 3-position of pyridine nucleus.

Structure of nicotine can be assigned from above reactions as given below which satisfies all the above reaction outcomes.



Nicotine



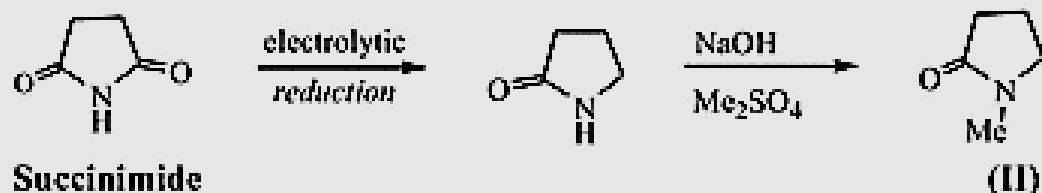
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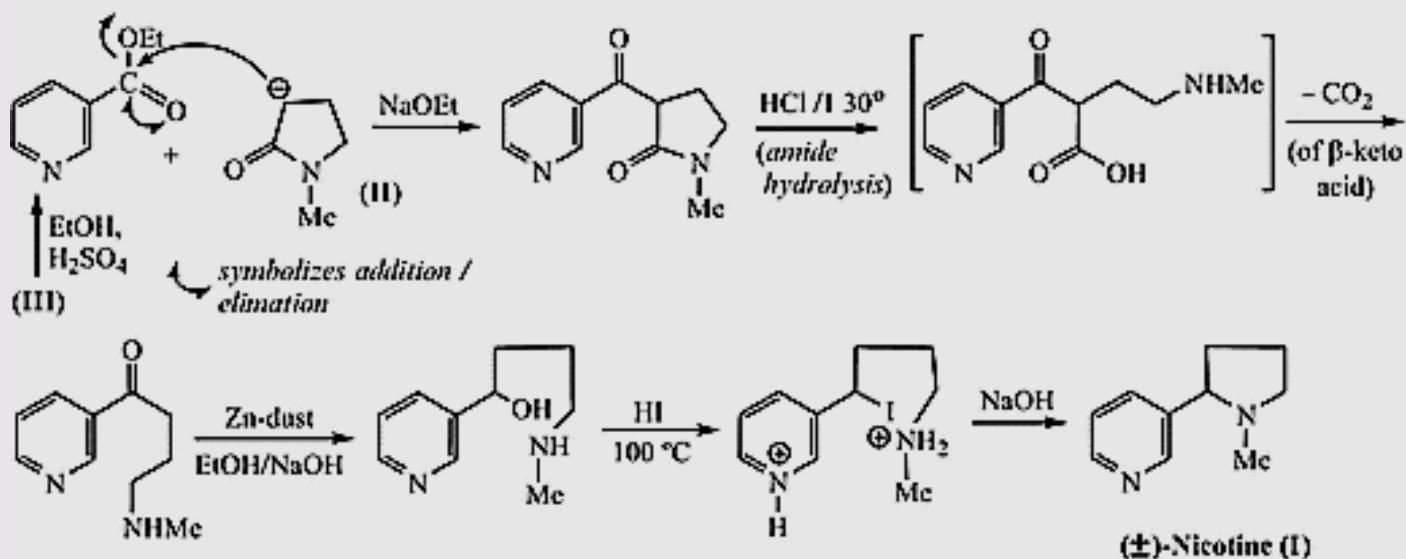
Spath and Bretschneider synthesis

Spath and Bretschneider synthesis of nicotine also establishes its structure as elucidated earlier.

Synthesis of N-methyl-2-pyrrolidone (II)



Synthesis of nicotine (I)





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References

1. K.D Sharma and Y. R. Sharma, Kalyani Publishers, Unit-III page-319;
2. University Chemistry, Vol-IV, Dr. U. N. Dash, Dr. K. K. Ojha, Himalaya Publishing house, Unit V, page-411