

FORMATION OF 3-HYDROXY-6-BENZYL-PYRIDINE FROM 5-BENZYL-FURFURAL AND AMMONIUM SULFATE

著者	SUGISAWA Hiroshi, ASO Kiyoshi, KOBAYASHI Kazuo
journal or publication title	Tohoku journal of agricultural research
volume	4
number	2
page range	189-192
year	1954-02-20
URL	http://hdl.handle.net/10097/29110

FORMATION OF 3-HYDROXY-6-BENZYL-PYRIDINE FROM 5-BENZYL-FURFURAL AND AMMONIUM SULFATE

By

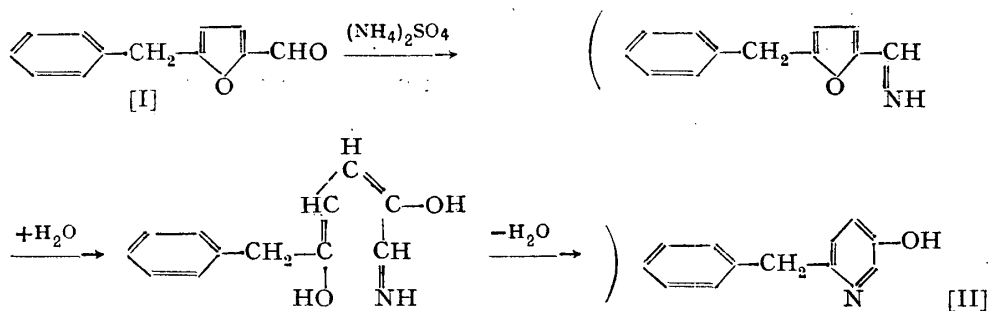
Hiroshi SUGISAWA, Kiyoshi ASO and Kazuo KOBAYASHI

*Department of Agricultural Chemistry, Faculty of
Agriculture, Tohoku University, Sendai, Japan*

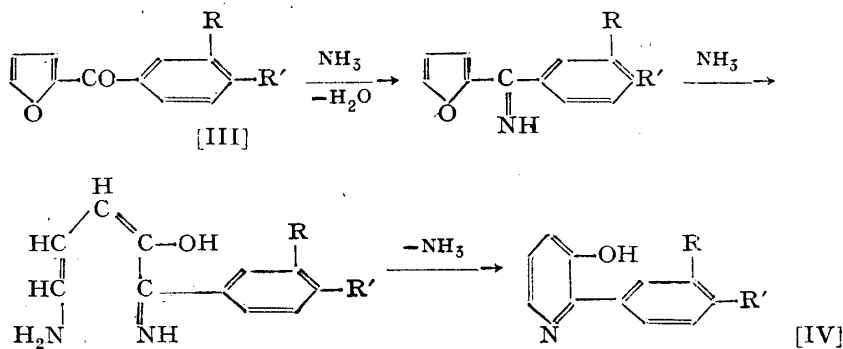
(Received November 13, 1953)

Aso¹⁾, one of the authors, previously reported that various kinds of β -hydroxy-pyridine derivatives had been obtained from furfural derivatives and ammonium salts.

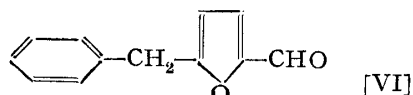
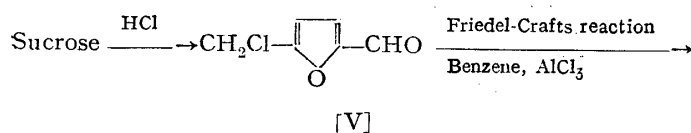
Now, we would like to report our findings that 3-hydroxy-6-benzyl-pyridine [II] was obtained similarly from 5-benzyl-furfural [I] and ammonium sulfate as shown in the following.



In 1952, Leditschke²⁾ also reported that he had synthesized 3-hydroxy-2-aryl-pyridine derivatives [IV] from phenyl-2-furyl-ketones [III] and ammonium salts.



Experimental



1) 5-Chloromethyl-furfural³⁾ [V]

In a 12 L round bottomed flask fitted with a cork bearing a thermometer and a large bent glass tube, was placed 6 L of 32 % hydrochloric acid (sp. gr. 1.16). The acid was heated to 50°C., and 1 kg. (2.92 moles) of powdered sugar was dissolved in the liquid with shaking. The dark-colored solution was heated rapidly to 70°~72°C., kept at this temperature for ten minutes, and poured at once onto 3 Kg. of cracked ice in a large beaker. After the mixture was cooled down to room temperature, the acid liquid was filtered with suction through a large Büchner funnel, to remove large quantities of humus produced. The humus on filter was washed with water, and the filtered liquid and aqueous washing was extracted several times with benzene.

The benzene extract was washed with sodium carbonate solution and washed with water, dried with anhydrous sodium sulfate. After the benzene was removed by warming gently, the residue was distilled under reduced pressure. 5-Chloromethyl-furfural was distilled at 123~129°C. / 19~20 mm. and the yield was about 100 g.

2) 5-Benzyl-furfural⁴⁾ [VI]

5-Benzyl-furfural was prepared by the reaction of 5-chloromethyl-furfural, benzene and aluminium chloride.

A mixture of 5-chloromethyl-furfural 10 g., anhydrous AlCl₃ 7 g. and excess 25 ml. of benzene was heated in a reflux apparatus for about 2 hours. Reaction began at about 40°C. with copious evolution of HCl gas, and the temperature was regulated so as to keep the liquid in a state of gentle boiling. The resulting dark, nearly opaque mixture was then allowed to cool, poured onto powdered ice, and submitted to steam distillation. The first portion of the distillation contained some of the product of the reaction dissolved in excess of benzene.

Afterwards, the main portion of the product passed over as an oil, which, on keeping, solidified to a crystallin mass. The product obtained was large, colorless prisms, melting at 30.5~31°C. The total yields was about 6 g.

5-Benzyl-furfural has a faint aromatic odour, somewhat resembling that of

nitro-benzene. It is almost insoluble in cold water, but dissolves readily in alcohol, benzene, ether, petroleum or acetic acid.

3) 3-Hydroxy-6-benzyl-pyridine [II]

5-Benzyl-furfural 10 g., ammonium sulfate 5 g. and water 100 ml. were heated in autoclave at 170~180°C. (about 9~10 atm.) for 3 hours.

After cooling, the reaction mixture was separated into oil layer and aqueous layer by separating funnel, and the aqueous layer was concentrated to about half of the original volume under reduced pressure, alkalinized with sodium carbonate and extracted with ether in the Soxhlet's extractor for 48 hours. After removal of the solvent, and cooling, light brown crystals were obtained. When it was recrystallized from benzene by the aid of charcoal, it was a colorless needle, m.p. 169~170°C. insoluble in water, but readily soluble in alcohol and ether. The yield was about 0.2 g.

The substance indicated a deep red color by FeCl₃ solution, a deep green color by Folin-Denis reagent, and n-butyl alcohol solution of this crystal showed no color reaction with 2,6-dichloroquinonechlorimide. Namely, Gibbs-reaction⁵⁾ was negative.

Microanalysis

sample (mg.)	CO ₂ (mg.)	H ₂ O (mg.)	C %	H %
2.767	7.873	1.586	77.56	6.35
1.986	5.730	1.164	78.65	6.49
		mean	78.10	6.42
		C ₁₂ H ₁₁ ON theoretical	77.84	5.95
sample (mg.)	N (cc.)	b (mm.)	t (C.)	N %
2.957	0.200	756	27	7.50
2.856	0.200	756	28	7.74
		mean		7.62
		C ₁₂ H ₁₁ ON theoretical		7.57

4) The picrate

A saturated ether solution of picric acid was added to the ether solution of this substance. The yellow crystal obtained was washed with water and ether, and recrystallized from hot-water. It was a yellowish needle, m.p. 133~135°C.

Microanalysis

Sample (mg.)	N (cc.)	b (mm.)	t (C.)	N %
2.641	0.323	756	28	13.52
2.572	0.312	756	28	13.41
		mean		13.46
		C ₁₂ H ₁₁ ON(NO ₂) ₃ C ₆ H ₂ (OH) theoretical		13.52

5) The acetyl derivative

This substance 0.05 g., fused sodium acetate 0.5 g. and acetic anhydride 5 g. were heated at 150°C. under reflux for 6.5 hours.

After removal of residual acetic anhydride under reduced pressure, the residue was extracted with ether, and the extract was washed with sodium carbonate solution and finally dried over anhydrous sodium sulfate.

After removal of the solvent, the crystal obtained was recrystallized from benzene by the aid of charcoal. It was a colorless needle, m.p. 113~115°C. This crystal showed no color reaction by FeCl₃ solution.

Summary

By heating 5-benzyl-furfural and ammonium sulfate in autoclave at a temperature of 170~180°C. for 3 hours, a colorless needle having a formula corresponding to C₁₂H₁₁ON was obtained.

This substance melts at 169~170°C. Its picrate is a yellowish needle, melts at 133~5°C. and the acetate is a colorless needle, m.p. 113~115°C. The substance obtained indicates a deep red color by FeCl₃, a deep green color by Folin-Denis reagent, and Gibbs-reaction is negative.

From the facts presented above, the authors believe the obtained crystal to be 3-hydroxy-6-benzyl-pyridine formed according to the formation mechanism described above.

Acknowledgement: We express our deep gratitude to the microanalyzer of the Department of Agricultural Chemistry, Faculty of Agriculture, Tokyo University. The work was aided in part by a grant from the Scientific Research Expenditure of the Ministry of Education.

References

- 1) Aso, K., (1953). *This Journal* **3**, 359.
- 2) Leditschke, H. (1952). *Ber.* **85**, 202.
- 3) Gilman, H. et al. *Org. Syn. Coll.* **2** 421.
Fischere, E. & Neyman, H. (1914). *Ber.* **47**, 974.
Middendorp, M. J. A. (1919). *Rec. Trav. Chim.* **38**, 1.
Aso, K. (1940). *J. Agr. Chem. Soc. (Japan)* **16**, 251.
- 4) Fenton, H. J. & Robinson, F. (1909). *J. Chem. Soc.* **95**, 1334.
Gilman, H. & Dickey, J. B. (1930). *J. Am. Chem. Soc.* **52**, 2011.
- 5) Gibbs, H. D. (1927). *J. Biol. Chem.* **72**, 649.
Stillier, R. J., Kereszteog J, C. & Stevens J. R. (1939). *J. Am. Chem. Soc.* **61**, 1237.