87. **Norio Sugimoto and Yoshishige Sato:** Syntheses of *p*-Nitrophenyl Ketones. IV[1]. Preparation of Some *p*-Nitrophenyl Alkyl Ketone Derivatives by the Starkey Reaction.

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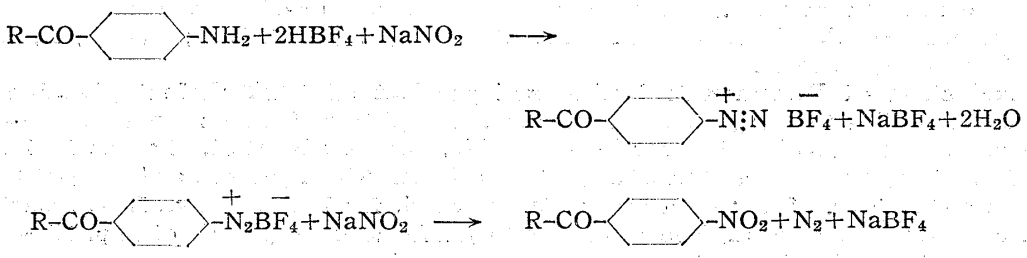
In the previous papers of this series[1~3], syntheses of *p*-nitrophenyl alkyl ketones by the Sandmeyer reaction, that of diazotizing *p*-aminophenyl alkyl ketones (alkyl=H, CH_3, C_2H_5, C_3H_7, C_4H_9, C_6H_5, *p*-CH_3-C_6H_4, $ClCH_2$, $BrCH_2$, CH_3COOCH_2, $C_6H_5OCH_2$, $CH_3CONHCH_2$) and decomposing with copper catalyst, were reported.

In the present series of experiments, various kinds of *p*-nitrophenyl alkyl ketones were prepared by the well-known Starkey method[4], that of decomposing diazonium borofluoride in aqueous solution of sodium nitrite with copper catalyst, which are described herein.

The present reaction may be shown by the following formulae:



In this reaction, *p*-aminophenyl alkyl ketone is dissolved, in the cold or by warming, in approximately 48% hydrofluoroboric acid prepared by dissolving hydrofluoric acid in cold boric acid, and to the solution of fluoroboric acid salt thereby formed, solution of sodium nitrite is added dropwise at below 0°. Irrespective of whether the crystals separate out or not, the diazonium borofluoride is not filtered but added dropwise into a mixture of Gattermann's copper and sodium nitrite solution. The precipitate thereby formed is suitably extracted, treated, and purified by recrystallization or by low-pressure distillation.

Comparison of the experimental results by the present Starkey method and by the previous Sandmeyer method shows that where the alkyl is hydrogen or methyl, the yield is slightly lower in the Starkey method while the yield by the Starkey method is 1.5~2 times that of the Sandmeyer method where the number of carbon atoms increases, presumably by the ease of diazonium borofluoride formation. Approximately equal yield is obtained when the alkyl is $ClCH_2$, while the yield of the compound with CH_3COOCH_2 group is one-half in the Starkey method.

A compound with $C_6H_5OCH_2$-group could not be prepared by the Sandmeyer method and it was also found to be impossible by the Starkey method, diazotization having failed to occur because of the insolubility of the *p*-aminophenyl compound in fluoroboric acid.

Some yellow amorphous substance was obtained from the compound with $(C_2H_5)_2$-NCH_2CH_2-group but it was not found to be the objective compound.

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1) N. Sugimoto, J. Iwao, Y. Komiyama: J. Pharm. Soc. Japan, 72, 195(1952).

2) S. Sugasawa, N. Sugimoto, J. Iwao, Y. Nakamura: *Ibid.*, 71, 225(1951).

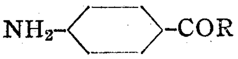
3) N. Sugimoto, J. Iwao, H. Kakemi: *Ibid.*, 71, 1161(1951).

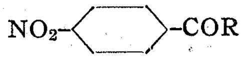
4) E.B. Starkey: J. Am. Chem. Soc., 59, 1479(1937).

Experimental

General Procedure—To fluoroboric acid placed in a three-necked flask, *p*-aminophenyl alkyl ketone is added in small portions and allowed to dissolve. If the ketone compound does not dissolve, the mixture is warmed for some time, dissolved completely, and the mixture is chilled. Aqueous solution of sodium nitrite is dropped in while chilling the mixture to below 0° and the diazonium borofluoride salt is formed. On the other hand, Gattermann's copper powder is floated on the solution of sodium nitrite and to this solution, maintained at around 15°, the foregoing diazonium solution is poured in for decomposition. After warming the mixture for one hour at 50~60°, when the reaction will be completed, the crystals, if any, are collected by filtration or extracted with a suitable solvent. When the product is non-crystalline or syrupy, it is extracted with a solvent, and purified by recrystallization or low-pressure distillation.

Various *p*-nitrophenyl alkyl ketones thereby obtained were confirmed by mixed fusion with the corresponding compounds prepared by the previous Sandmeyer reaction.





R		HBF$_4$[a]	NaNO$_2$	CuSO$_4$·5H$_2$O	Zn	NaNO$_2$	Yield		m.p.
	(g.)	(cc.)	(g.)	(g.)	(g.)	(g.)	g.	%	°C
H	3.15	40	1.7	20	5	20	1.4	35	106
CH_3	3.4	60	1.7	20	5	20	2.4	58	80.5
C_2H_5	3.75	40	1.7	20	5	20	2.3	51.5	89
C_4H_9	4.42	45	1.7	20	5	20	2.4	46	30
C_6H_5	4.5	40	1.7	20	5	20	3.0	54	135
$ClCH_2$	4.0	40	1.65	20	5	20	1.5	32	89
CH_3COOCH_2	3.9	20	1.4	16	4	16	1.4	31	122
$C_6H_5OCH_2$[b]	0.6	60	0.2						
$(C_2H_5)_2NCH_2CH_2$[c]	2.5	20	0.9	10	2.5	10			

a) Aqueous solution of approx. 48% HBF$_4$.
b) Given up because of insolubility in HBF$_4$ aq. solution.
c) Yellow amorphous powder obtained but not the objective compound.

Summary

Following the Starkey method, various *p*-aminophenyl alkyl ketones were diazotized in hydrofluoroboric acid with sodium nitrite and decomposed with copper catalyst to the corresponding *p*-nitrophenyl alkyl ketones. The results were compared with those obtained previously by the Sandmeyer method.

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