THE REACTION OF 8,8-DISUBSTITUTED HEPTAFULVENES WITH AMINES IN THE PRESENCE OF COPPER(II) ACETATE

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The reaction of 8,8-dicyanoheptafulvene (<u>la</u>) with ammonia and several kinds of amines in the presence of copper(II) acetate afforded 1,2-dihydro-2-iminocyclohepta[b]pyrrole derivatives (<u>2</u>) and/or 3-aminoisoquinoline derivatives (<u>3</u>). The reaction of 8-cyano-8methoxycarbonylheptafulvene (<u>lb</u>) and amines has also been described.

In the course of the investigations on the oxidative amination of sevenmembered aromatics,¹⁾ it was found that the reaction of 8,8-dicyanoheptafulvene (<u>1a</u>) and 8-cyano-8-methoxycarbonylheptafulvene (<u>1b</u>) with amines in the presence of copper(II) acetate gave cyclohepta[b]pyrrole derivatives (<u>2</u>) and/or 3-aminoisoquinoline derivatives (<u>3</u>). Present communication describes these novel oxidative cyclization and rearrangement reactions.

The treatment of <u>la</u> (1.54 g) and copper(II) acetate (4.00 g) in methanol (30 ml) with concd. ammonia (8 ml) at room temperature for 70 h gave 1,2dihydro-2-iminocyclohepta[b]pyrrole-3-carbonitrile (<u>2a</u>)²) and 3-aminoisoquinoline-4-carbonitrile (<u>3a</u>) [mp 168-169°C; UV (EtOH), λ_{Max} , nm (log ε): 241 (4.76), 276 (3.77), 286 (3.70), 384 (3.67); NMR (DMSO-d₆), δ , ppm: 7.1~8.2 (C₅-H~C₈-H, and NH₂, m), 9.12 (C₁-H, s)] in about 44% and 26% yields, respectively. The acid hydrolysis and decarboxylation of <u>3a</u> gave 3-aminoisoquinoline. The similar treatment of <u>la</u> with methylamine, ethylamine, and benzylamine (room temperature, 0.5~1 h) gave corresponding 1,2-dihydro-1methyl²)-(ethy1, and benzy1)-2-iminocyclohepta[b]pyrrole-3-carbonitriles (<u>2b</u>, <u>2c</u>, and <u>2d</u>), respectively. Their melting points, yields, and the spectral data are shown in Table 1.

Compounds	Mp (°C) 181-183	Yields (%) 30	λ _{Ma}	UV (EtOH _x , nm (loo	NMR (CDCl ₃ , ppm =NH		
			228 (4.11)	283 (4.38)	435 ^{a)} (4.05)		
<u>2c</u>	147-148	30	230 (4.14)	283 (4.43)	434 (4.10)	6.32	
<u>2d</u>	158-159	26	230 (4.13)	284 (4.38)	437 (4.12)	6.17	
<u>2e</u>	130-131	10	245 (4.25)	286 (4.41)	420 (4.08)	6.5~7.5 ^{b)}	

Table 1. The melting points, yields, and the spectral data of 1,2-dihydro-2-iminocyclohepta[b]pyrrole derivatives (2)

a) Lit.,²⁾ mp 185°C. UV (EtOH), λ_{Max} , nm (log ϵ): 228 (4.16), 281 (4.45), and 433 (4.17).

b) Overlapped with aromatic protons.

On the other hand, the reaction of <u>la</u> with pyrrolidine in the presence of copper(II) acetate at room temperature for l h gave 3-pyrrolidinoisoquinoline--4-carbonitrile (<u>3b</u>) as yellow needles, mp 152-153.5°C, yield, 68%. UV (EtOH), λ_{Max} , nm (log ϵ): 255 (4.65), 295 (4.17), 405 (3.68). NMR (CDCl₃), δ , ppm: 7.2~8.1 (C₅-H~C₈-H, m), 8.97 (C₁-H, s). Permanganate oxidation of <u>3b</u> gave phthalic acid. Acid hydrolysis and decarboxylation of <u>3b</u> gave 3-pyrrolidinoisoquinoline (<u>4</u>), mp 84-85.5°C. UV (EtOH), λ_{Max} , nm (log ϵ): 246 (4.60), 294 (4.19), 303 (4.28), 393 (3.41). Similarly, the treatment of <u>la</u> with dimethylamine, piperidine, and morpholine gave 3-dimethylamino-(piperidino, and morpholino)-isoquinoline-4-carbonitriles (<u>3c</u>, <u>3d</u>, and <u>3e</u>), respectively. Their melting points, yields, and the spectral data are shown in Table 2.

The reaction of 8-cyano-8-methoxycarbonylheptafulvene (<u>lb</u>), which was prepared under a similar manner for the preparation of 8-cyano-8-ethoxycarbonylheptafulvene,³⁾ with benzylamine in the presence of copper(II) acetate



Compounds	Мр (°С)	Yields (%)	UV (EtOH) λ_{Max} , nm (log ϵ)			NMR	NMR (CDCl ₃ , ppm) C ₁ -H		
<u>3c</u>	103-104	37	253 (4.61)	293 (4.09)	398 (3.65)			9.00	(s)
<u>3d</u>	88-89	52	257 (4.56)	298 (4.17)	402 (3.61)			9.05	(s)
<u>3e</u>	116-117	22	254 (4.51)	295 (4.10)	390 (3.57)			9.04	(s)
<u>3f</u>	101-102	46	249 (4.71)	401 (3.77)				8.88	(s)
<u>3g</u>	98-99	28	225 (4.34)	266 (4.51)	312 (4.37)	406 (3.77)		8.95	(s)
<u>3h</u>	109-110	29	225 (4.34)	266 (4.51)	312 (4.36)	411 (3.77)		8.95	(s)
<u>3i</u>	114-115	19	228 (4.33)	266 (4.50)	310 (4.32)	413 (3.76)		8.92	(s)
<u>3j</u>	153-154	18	228 (4.37)	270 (4.52)	317 (4.50)	405 (3.84)		8.97	(s)

Table 2. The melting points, yields, and the spectral data of 3-aminoisoquinoline derivatives $(\underline{3})$

gave orange red needles (<u>2e</u>), mp 130-131°C, and pale yellow needles (<u>3f</u>), mp 101-102°C. Elemental analysis and spectral data of <u>2e</u> (Table 1) an <u>3f</u> (Table 2) indicate that the former is methyl 1,2-dihydro-1-benzyl-2-iminocyclohepta[b]pyrrole-3-carboxylate, and the latter is methyl 3-benzylaminoisoquinoline-4carboxylate.

The reaction of <u>la</u> with aromatic amines did not afford clear results. However, the reaction of <u>lb</u> with aniline, p-toluidine, p-anisidine, and p-bromoaniline under a similar condition (room temperature, $1 \sim 1.5$ h), gave methyl 3-anilino-(3-p-toluidino, 3-p-anisidino, and 3-p-bromoanilino)isoquinoline-4-carboxylates (<u>3g</u>, <u>3h</u>, <u>3i</u>, and <u>3j</u>), respectively. Their structures were established by the elemental analyses and the spectral data, especially by the characteristic C₁-H signal (singlet at about 9 ppm) in the NMR spectra as shown in Table 2.

The rearrangement reaction of 2-amino-3-bromotropone derivatives with active methylene compounds to give quinoline derivatives has been reported.⁴⁾

However, the rearrangement of 8,8-disubstituted heptafulvenes into 3-aminoisoquinoline derivatives under an oxidative process is, in our knowledge, the first example in the seven-membered aromatic compounds.

References

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