

## ANALOGS OF ATOPHAN CONTAINING A FURAN NUCLEUS

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By the reaction of isatin and 5-, 6-, and 7-methylisatins with 2-acetylfuran and 2-acetylbenzofuran in an alkaline medium new analogs of atophan have been synthesized. The compounds obtained are physiologically active substances and plant growth stimulators.

In order to study the biological activity of various heterocycles, we have synthesized a number of analogs of atophan containing five-membered O, S, and N heterocycles in position 2 in place of a benzene nucleus. Below we give the syntheses of 2-furyl- and 2-benzofurylcinchonic acids. In an attempt to keep to a minimum the polymerization reaction that competes with the cyclization of 2-acetylfuran, we carried out the reaction under milder conditions than those customary in the Pfitzinger reaction [1, 2]. The condensation reaction with 2-acetylbenzofuran was carried out under more severe conditions since the vinyl ether in the furan part of the molecule was stabilized by the presence of the benzene ring.

It is known from literature sources that 2-furylcinchonic acid possesses 65-75% of the activity of atophan [3] and is of interest as a plant growth stimulator. We obtained it with a better yield than by the previously known method. The compounds obtained were tested as plant growth stimulators by Docent P. F. Stadnichuk of the Department of Botany of the Novocherkask Engineering and Development Institute. 2-Furylcinchonic acid gave an increase in the yield of green mass by 15.5%.

Data on the properties of the products synthesized are given in the table.

## EXPERIMENTAL

**2-Acetylfuran** was obtained by acetylating furan with acetic anhydride [4, 5].

**2-Acetylbenzofuran** was synthesized from salicylaldehyde and chloroacetone [6, 7].

**2-Furylcinchonic acid (I)**. A round-bottomed flask connected with a reflux condenser was charged with 1.5 g (0.01 mole) of isatin,

12 ml of ethanol, 2 ml of 33% caustic soda solution, and 2.1 g (0.0187 mole) of acetylfuran. The flask was heated in the water bath at 80-85° C for 1 hr 50 min. With stirring, the filtered solution was carefully acidified to pH 3-2 with dilute hydrochloric acid (1:1). After standing for 12 hr, the yellowish-green precipitate obtained was washed and was dissolved in a 2.5% solution of sodium acetate. The solution was diluted to 100 ml with water, treated with 5 g of common salt, and left for 36 hr. Colored impurities deposited. The filtrate was acidified with dilute hydrochloric acid, and the product that separated was recrystallized from dilute ethanol. The yield was calculated to acetylfuran. Compound I is a yellowish-green crystalline powder soluble in ethanol and acetone and insoluble in water.

**6-Methyl-2-furylcinchonic acid (II)** was obtained similarly.

**2-Benzofurylcinchonic acid (III)** was obtained by gently boiling for 6 hr 3 g (0.02 mole) of isatin, 5.98 g (0.053 mole) of 2-acetylbenzofuran, 12 ml of ethanol, and 6 ml of 33% sodium hydroxide solution. Compound III is soluble in ethanol and insoluble in water.

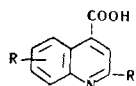
**6-Methyl-2-benzofuryl- (IV), 7-methyl-2-benzofuryl- (V), and 8-methyl-2-benzofurylcinchonic acid (VI)** were obtained similarly; they are soluble in ethanol and acetone and insoluble in water.

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Compound	R	R'	Mp, °C	Empirical formula	Found, %			Calculated, %			Yield, %
					C	H	N	C	H	N	
I	H	2-Furyl	210	C <sub>14</sub> H <sub>9</sub> O <sub>3</sub> N	69.8	3.5	5.5	70.2	3.7	5.8	56.0
II	6-CH <sub>3</sub>	2-Furyl	250	C <sub>15</sub> H <sub>11</sub> O <sub>3</sub> N	70.9	4.1	5.3	71.1	4.3	5.5	54.0
III	H	2-Benzofuryl	272	C <sub>16</sub> H <sub>11</sub> O <sub>3</sub> N	74.4	3.5	4.7	74.7	3.8	4.8	60.0
IV	6-CH <sub>3</sub>	2-Benzofuryl	262	C <sub>19</sub> H <sub>13</sub> O <sub>3</sub> N	75.0	4.0	4.4	75.2	4.2	4.5	61.1
V	7-CH <sub>3</sub>	2-Benzofuryl	244	C <sub>19</sub> H <sub>13</sub> O <sub>3</sub> N	74.8	3.9	4.0	75.2	4.2	4.5	59.8
VI	8-CH <sub>3</sub>	2-Benzofuryl	240	C <sub>19</sub> H <sub>13</sub> O <sub>3</sub> N	74.9	3.8	4.3	75.2	4.2	4.5	59.9